Table of contents

Instruction: W0010032

:
: 0 001 372 ..

Continue: A01

Table of contents

Continue: IV12/1

SPECIAL FEATURES

These instructions describe repair operations for sliding-gear starting motors of type IE 0 001 372 ...

- 24 V/6.2 KW

The bearing pin of the engaging lever in the drive-end bearing and the solenoid-switch bolts are to be secured again with Loctite 5 965 930 512 on assembly.

Continue: I02/2

SPECIAL FEATURES

The needle bushings in the drive-end and intermediate bearing are to be renewed. The repair version for replacement of the needle bushing in the drive-end bearing has a different appearance to the original equipment.

The carbon brushes and helical compression springs are always to be replaced.

Continue: I03/1

SPECIAL FEATURES

In the event of partial starting-motor repair, the carbon brushes and brush holder may not have to be checked or replaced.
In such cases, the special tool 0 986 617 122 (KDAL 5035) can be used to center the brush holder and fix the carbon brushes.
This makes starting-motor assembly much easier.

Continue: I03/2

SPECIAL FEATURES

As far as the solenoid switch is concerned, there is no means of testing which provides reliable information on trouble-free operation over a lengthy period.
It is therefore advisable to renew the solenoid switch as well when repairing the starting motor.

The fitting mandrel, which has to be made for installing the excitation winding, should be hardened and ground so as not to damage the pole shoes.

Continue: I01/1

STRUCTURE, USAGE

PC user prompting:
Position cursor on button and confirm.
Microcard user prompting:
User prompting is provided on every page e.g.:
- Continue: I 17/1
- Continue: II 18/1 Fig.: II 17/2

Brief instructions may include several rows of coordinates.
I../. = first coordinate row
II../. = second coordinate row
III../. = third coordinate row
etc.

.../1 = upper coordinate half
.../2 = lower coordinate half

Continue: I01/1

GENERAL

Unless otherwise stated, the voltages indicated in these instructions are DC voltages.
AC voltages are marked by the symbol " * ".

Continue: I05/2

GENERAL

Expert repairs are only possible using the prescribed tools and measuring instruments, which are in perfect working order. We therefore recommend that exclusive use be made of the tools listed.

The use of incorrect and unsuitable tools and testers can lead to injury and may damage the product concerned or its component parts.

Continue: I06/1

GENERAL

Only use replacement parts given in the service parts list for the starting motor concerned.

Proper functioning presupposes use of the lubricants specified in these instructions, both prior to and during assembly.

Absolute cleanliness is to be ensured when performing repair work.

Continue: I01/1

SAFETY MEASURES

Component cleaning:
Armature, excitation winding, solenoid switch and overrunning-clutch drive are only to be cleaned using compressed air (max. 4 bar) and a clean cloth. Liquid cleaning agents are never to be employed.

Other parts such as intermediate and drive-end bearing can be washed out in commercially available cleaning agent which is not readily flammable. Take care not to inhale vapours.

Continue: I07/2

SAFETY MEASURES

Danger of fire: Take care to avoid naked flames and sparking.

ATTENTION:
Make sure parts which have been cleaned are thoroughly dried, as gases subsequently forming in the sealed starting motor can lead to an explosion.

Always use the listed tools. Injuries cannot be precluded if use is made of incorrect and unsuitable tools and testers.

Continue: I08/1

SAFETY MEASURES

Always heed the following safety regulations:

* German Order governing the use of flammable liquids (VbF).
* Accident prevention regulations for electrical systems and equipment.
* Safety regulations for the handling of chlorinated hydrocarbons:
  - For companies: ZH 1/222
  - For employees: ZH 1/129

  issued by the German industrial liability insurance associations (central association for accident prevention and industrial medicine), Langwartweg 103, 53129 Bonn.

Continue: I08/2

SAFETY MEASURES

Outside Germany, pay attention to appropriate local regulations.

Skin protection:
To avoid skin irritation when handling oil and grease, apply hand cream before starting work and wash cream off when finished with soap and water.

Continue: I01/1

TESTERS, EQUIPMENT, TOOLS

All the tools required for repairing starting motors of type IE are listed in the following.

Some of the necessary tools have to be improvised in line with the drawings.

The type designation is given in parentheses for tools which used to be ordered on this basis.

Continue: I09/2

TESTERS, FIXTURES, TOOLS

Interturn short-circuit tester with test probes:	0 986 619 110
Test prods:	0 986 619 101
(Old version:	0 986 619 114)
Alternator tester WPG 012.00:	0 684 201 200
(alternatively, Motortester)	
Magnetic measurement stand:	4 851 601 124
Dial indicator:	1 687 233 011
Mandrel press:	comm. avail.

Continue: I10/1

TESTER, EQUIPMENT, TOOLS

Clamping support:	0 986 619 362 (KDAW 9999)
Flat-nose pliers:	comm. avail.
Torque wrench (0...70 Nm):	comm. avail.
Torque meter (0.15...0.80 Nm):	0 986 617 206 (KDAL 5485)
Stay bolt insertion and removal tool:	comm. avail.

Continue: I10/2

TESTERS, EQUIPMENT, TOOLS

Spring balance (2...12 N):	0 986 619 181 (KDAW 9991)
Pole-shoe screwdriver:	0 986 619 393 (KDAW 9999/7)
Torx T50 bit socket with hexagon 5/16":	comm. avail.
Torx T40 bit socket with hexagon 1/4":	comm. avail.

Continue: I11/1

TESTERS, EQUIPMENT, TOOLS

Carbon-brush assembly tool:	0 986 617 117 (KDAL 5032)
Puller:	0 986 617 243
Spring collet 14.3 mm:	0 986 617 251
Pressing-out mandrel for needle bushing in intermediate bearing:	0 986 617 129 (KDAL 5039)

Continue: I11/2

TESTERS, FIXTURES, TOOLS

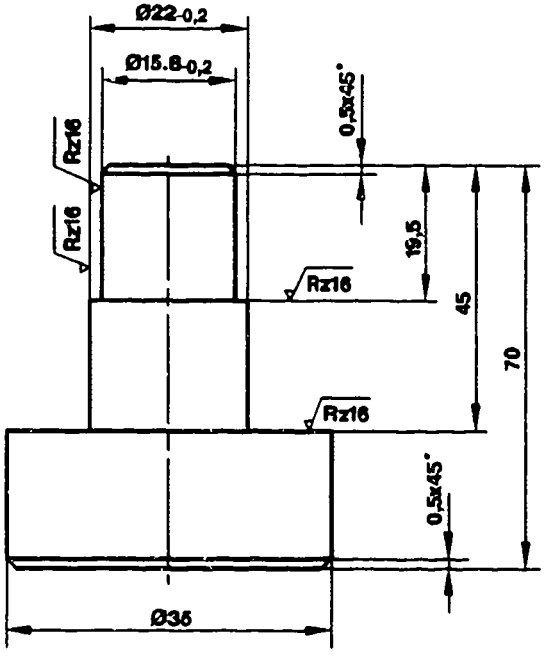
Tailstock rest with Morse taper 2 for chucking diameter 5...45 mm for holding armature when turning down:	0 986 619 156 (KDAW 9987)
Fitting mandrel diameter:	75,80...75,85 mm (own make)

Continue: I12/1

Pressing-out mandrel for needle bushing in drive-end bearing: to be improvised

Continue: I13/1 Fig.: I12/2

KMS00200



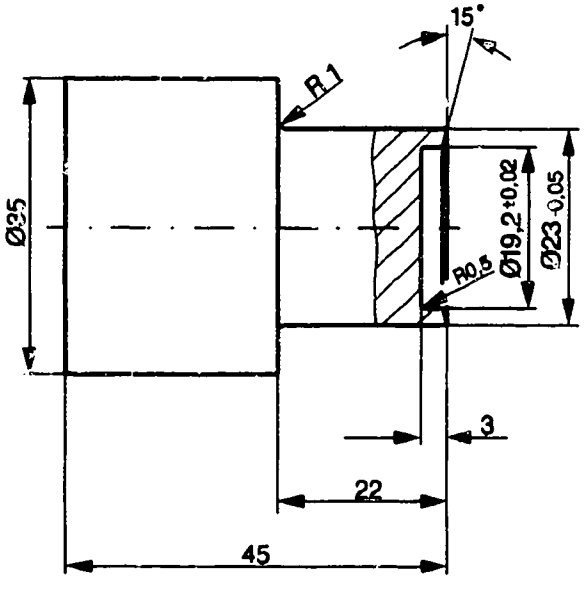
$\sqrt{Rz63}$ $(\sqrt{Rz16})$

TESTERS, EQUIPMENT, TOOLS

Pressing-in mandrel for needle bushing in drive-end bearing: to be improvised

Continue: I14/1 Fig.: I13/2

KMS00159

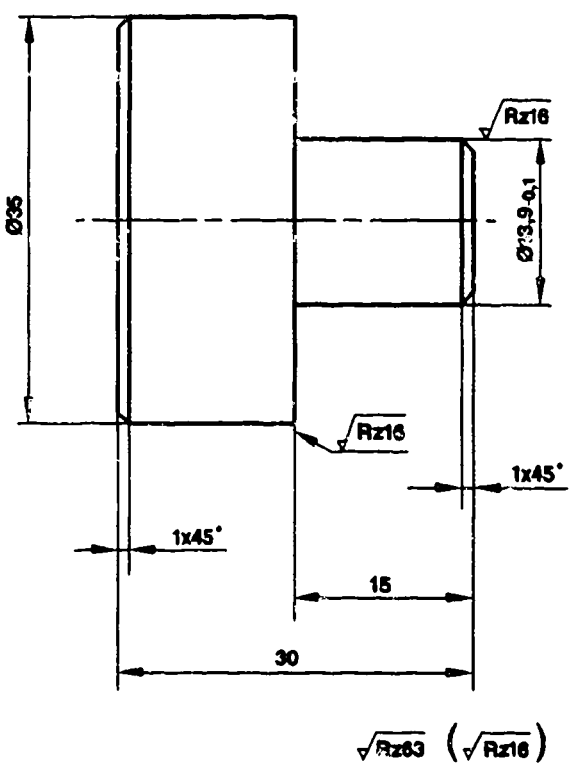


TESTERS, FIXTURES, TOOLS

Fitting mandrel for bushing diameter 14.3 mm in commutator end shield: Own make

Continue: I15/1 Fig.: I14/2

KMS00243

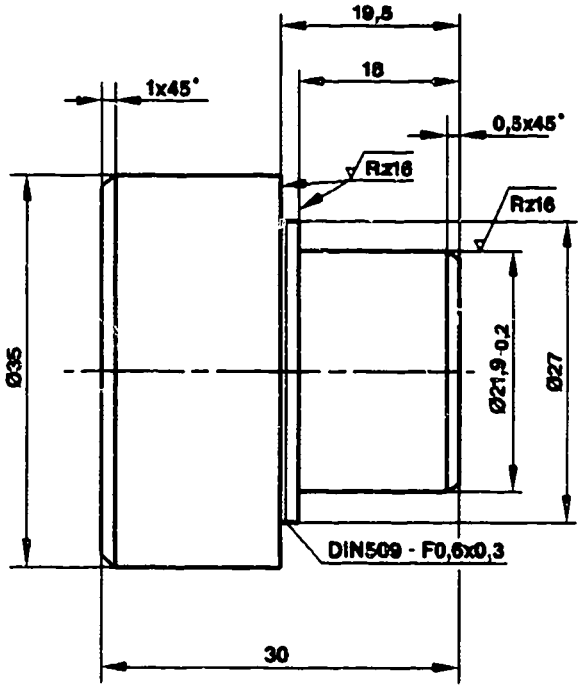


$\sqrt{Rz63}$ $(\sqrt{Rz16})$

Pressing-in mandrel for
needle bushing in
intermediate bearing: to be improvised

Continue: I16/1 Fig.: I15/2

KMS00210

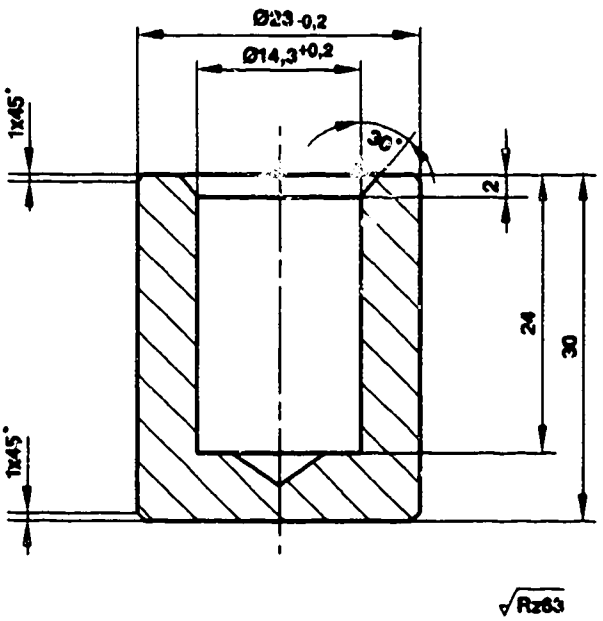


TESTERS, FIXTURES, TOOLS

Centering sleeve for brush holder: Own make

Continue: I01/1 Fig.: I16/2

KMS00244



TEST SPECIFICATIONS AND SETTINGS

Commutator minimum diameter:	42,5 mm
Eccentricity	
- Commutator:	< 0,03 mm
- Laminated core:	< 0,08 mm
Carbon brush as-new size:	15,5 mm
Carbon brush minimum size:	7,5 mm
Armature axial clearance:	0,05...0,40 mm

Continue: I17/2

TEST SPECIFICATIONS AND SETTINGS

Armature braking torque:	0,8...1,2 Nm
Pinion rest position a:	47...49 mm
Total pinion travel b:	68,2...70,8 mm
Pinion displacement:	10...11,4 mm
Resistance of shunt field:	1,08...1,18 Ohm

Continue: I18/1

TEST SPECIFICATIONS AND SETTINGS

Resistances of solenoid-switch
pull-in winding: 0,524...0,552 Ohm

Holding winding: 1,6...1,7 Ohm

Continue: I01/1

TIGHTENING TORQUES

Bearing-end plate attachment to commutator end shield:	4,5...6,0 Nm
Securing nuts of commutator end shield:	9,1...12,2 Nm
Stay bolt in drive-end bearing:	9,1...12,2 Nm
Sol. switch attachment:	6,7...8,4 Nm

Continue: I19/2

TIGHTENING TORQUES

Bearing pin of engaging lever in drive-end bearing (hexagon nut):	9...11 Nm
Pole-shoe screws:	40...53 Nm
Ground terminal stud, brush-holder plate:	12...15 Nm
Connection, excitation winding at solenoid switch:	16...20 Nm

Continue: I01/1

LUBRICANTS/LUBRICATION CHART

General:
Commutator and carbon brushes are to be kept free of grease and oil.

Greased parts are to be degreased prior to re-lubrication.

Slightly lubricate bright parts (bolts, nuts, fits, etc.).
Oil 41 v 2: 5 701 351 000

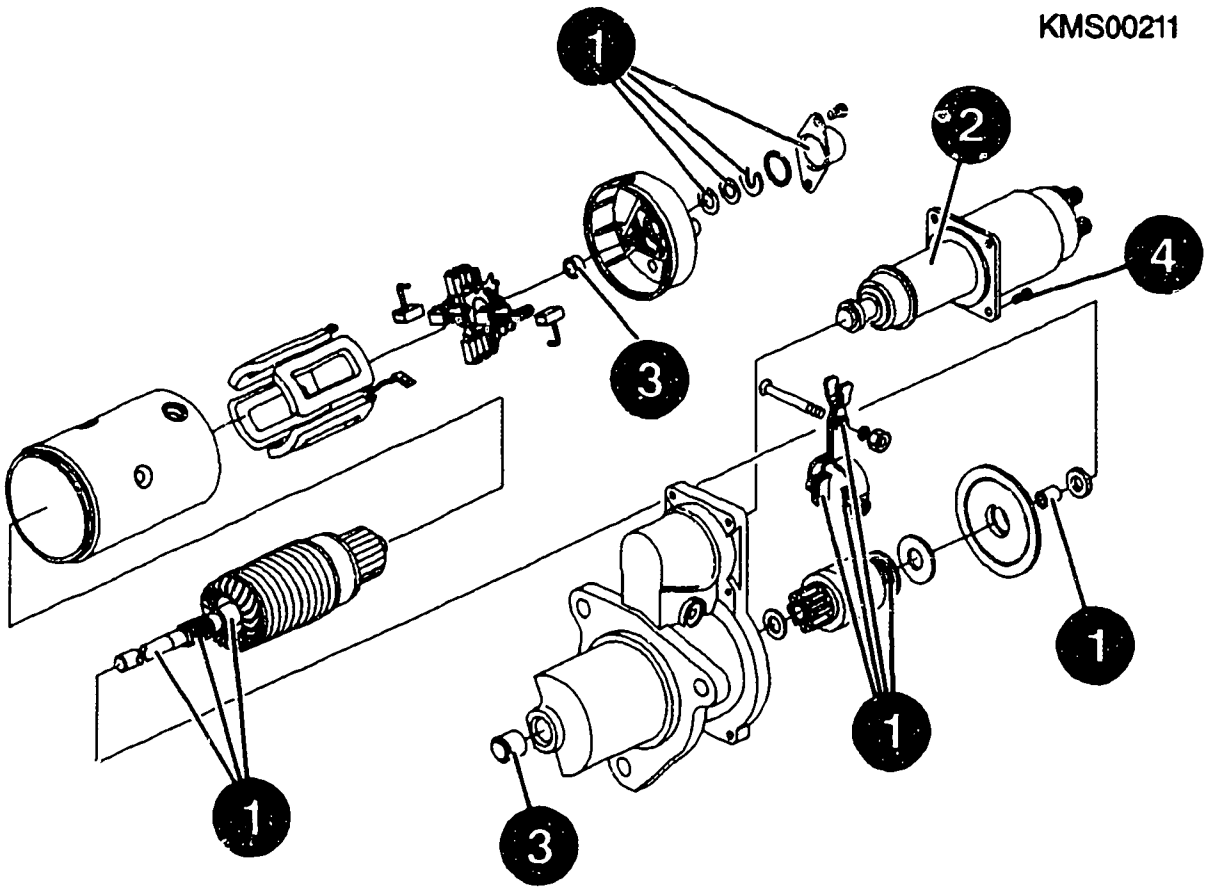
New bushings must be immersed in oil for approx. 1 hour before fitting.
Oil VS 13 834-Ö1: 5 962 260 000

Continue: I21/1

LUBRICANTS/LUBRICATION SCHEDULE

1	=	Grease VS 10832 Ft	5 932 240 000
2	=	Gleit mo 1580 V	5 996 328 000
3	=	Oil VS 13 834-Öl:	5 962 260 000
4	=	Loctite locking compound VS 14618 Kk	5 965 930 512

Continue: I01/1 Fig.: I21/2

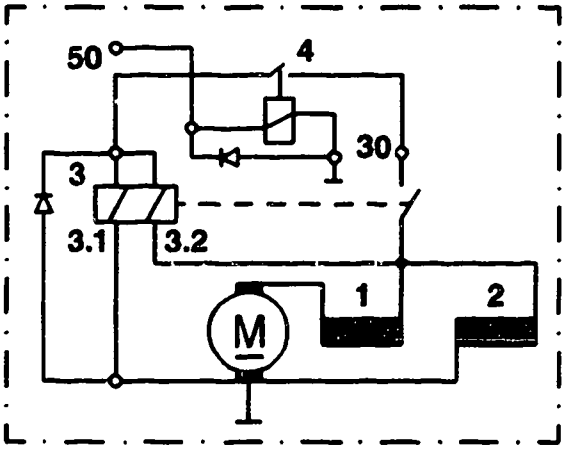


CIRCUIT DIAGRAM

1 = Series winding
2 = Shunt winding
3 = Solenoid switch
3.1 = Holding winding
3.2 = Pull-in winding
4 = Control relay

Continue: I01/1 Fig.: I22/2

KMS00232



STARTING MOTOR DISASSEMBLY TABLE

Solenoid switch disassembly	I24/1
Bearing-end plate disassembly	I27/1
Commutator end shield disassy.	II01/1
Carbon brush disassembly	II02/1
Brush holder plate disassembly	II04/1
Drive-end bearing disassembly	II05/1
Drive disassembly	II07/1
Intermediate bearing disassy.	II08/1
Armature disassembly	II09/1

Continue: I01/1

STARTING-MOTOR DISASSEMBLY

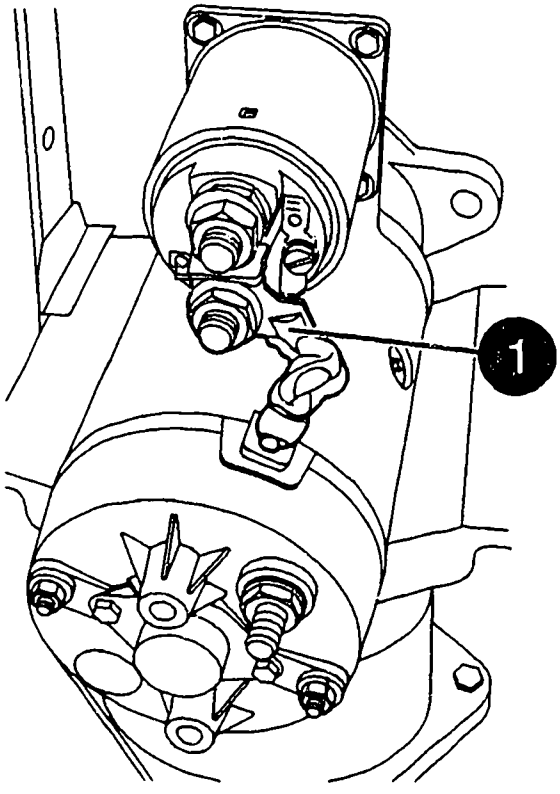
Solenoid-switch disassembly

Clamp starting motor in clamping support. Unfasten connection (1) of excitation winding at solenoid switch.

Clamping support: 0 986 619 362

Continue: I25/1 Fig.: I24/2

KMS00209



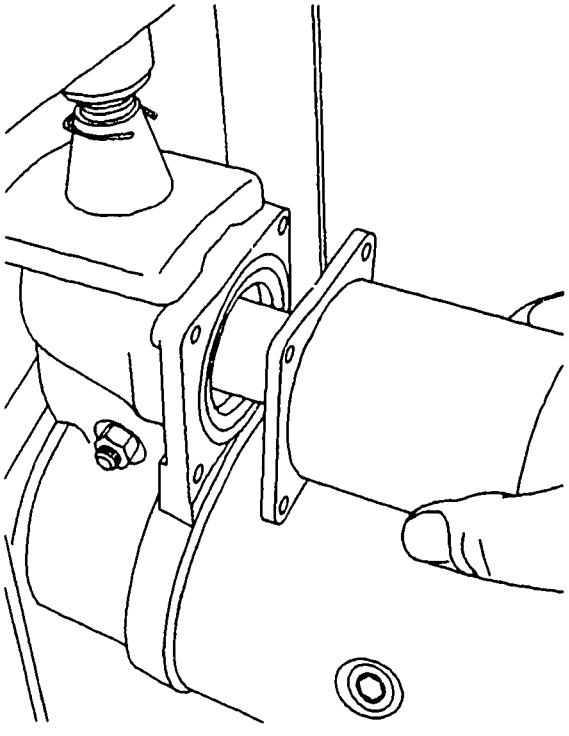
STARTING MOTOR DISASSEMBLY

Disassembling solenoid switch

Mark position of solenoid switch.
Unfasten solenoid switch bolts.
DANGER OF INJURY
The pretensioned return spring causes the solenoid switch to be pressed down by the switch armature.
Pull solenoid switch off switch armature.

Continue: I26/1 Fig.: I25/2

KMS00164



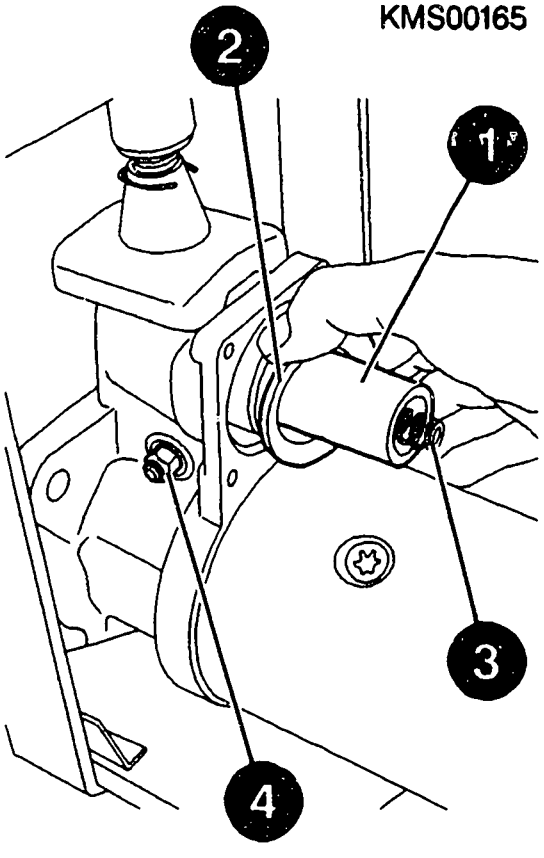
STARTING MOTOR DISASSEMBLY

Disassembling solenoid switch

Grasp switch armature (1) at bellows (2) and disengage at engaging lever.
Pay attention to return spring (3) in solenoid switch armature.
Slacken off bearing pin (4) of engaging lever in drive-end bearing.

Torx T40 bit socket: comm. avail.

Continue: I23/1 Fig.: I26/2



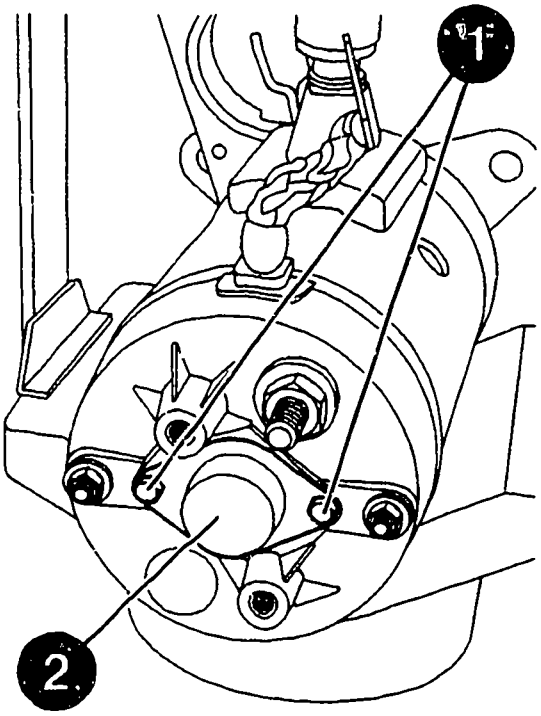
STARTING-MOTOR DISASSEMBLY

Bearing end plate disassembly

Turn starting motor round in clamp. Unfasten screws (1) of bearing end plate (2). Remove bearing end plate and seal.

Continue: I28/1 Fig.: I27/2

KMS00212



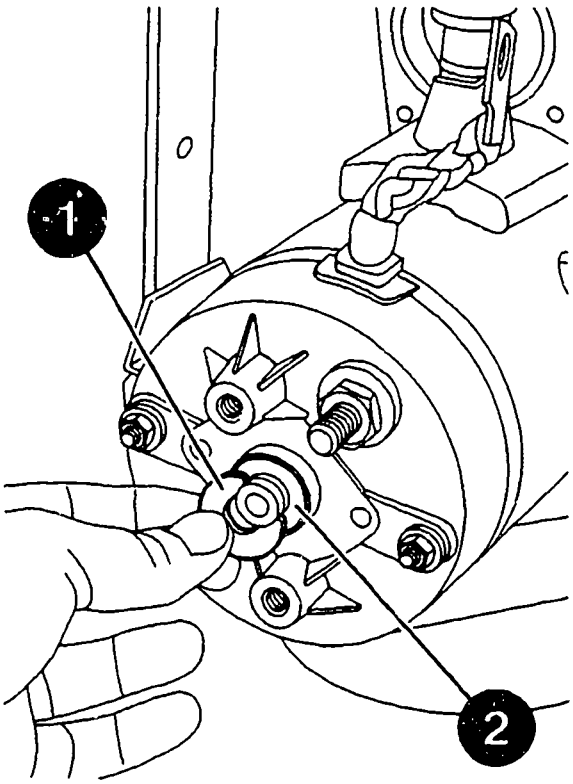
STARTING-MOTOR DISASSEMBLY

Bearing end plate disassembly

Remove locating washer (1) of armature shaft and shim (2).

Continue: I23/1 Fig.: I28/2

KMS00213



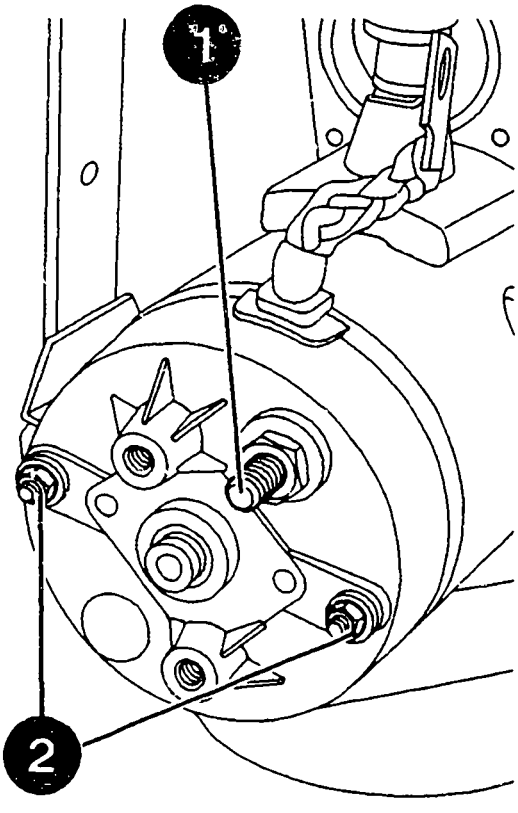
STARTING MOTOR DISASSEMBLY

Disassembling commutator end shield

Detach ground connection (1) of brush holder plate.
Unfasten nuts (2) of commutator end shield.
Remove commutator end shield.
Pay attention to insulating sleeve of ground terminal stud.

Continue: I23/1 Fig.: II01/2

KMS00214



STARTING MOTOR DISASSEMBLY

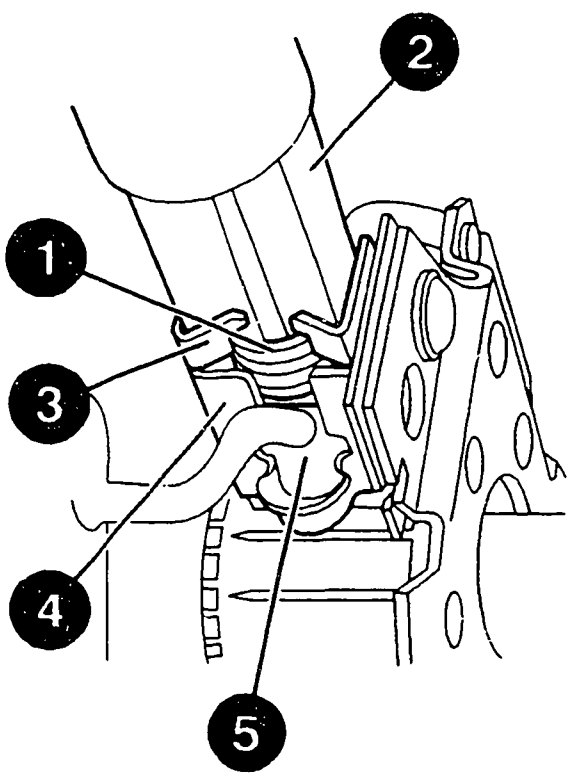
Disassembling carbon brushes

Use assembly tool (2) to press down helical compression spring (1).

Carbon brush assembly tool: 0 986 617 117

Continue: II03/1 Fig.: II02/2

KMS00215



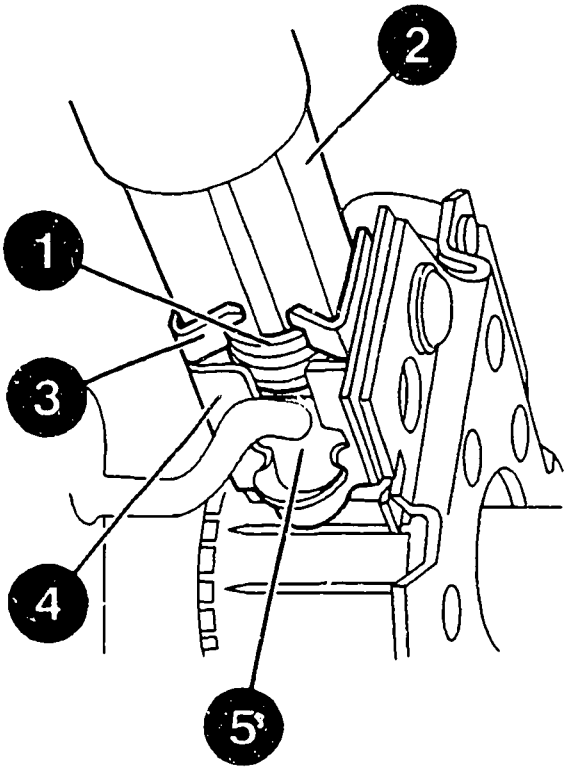
STARTING-MOTOR DISASSEMBLY

Carbon-brush disassembly

Bend open retaining lugs (3) of tubular brush holder (4) and remove helical compression spring (1).
ATTENTION: DANGER OF INJURY
Spring is pretensioned and jumps out on bending open the retaining lugs.
Remove both positive carbon brushes (5) from insulated tubular brush holders.

Continue: I23/1 Fig.: II03/2

KMS00215



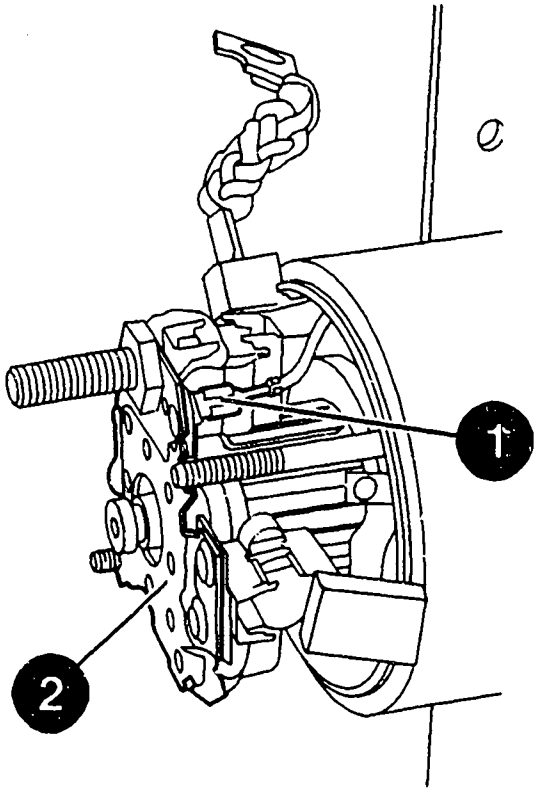
STARTING MOTOR DISASSEMBLY

Disassembling brush holder plate

Detach connection of excitation winding (1).
Remove brush holder plate (2) and thrust washer from armature shaft.

Continue: I23/1 Fig.: II04/2

KMS00216



STARTING MOTOR DISASSEMBLY

Disassembling drive-end bearing

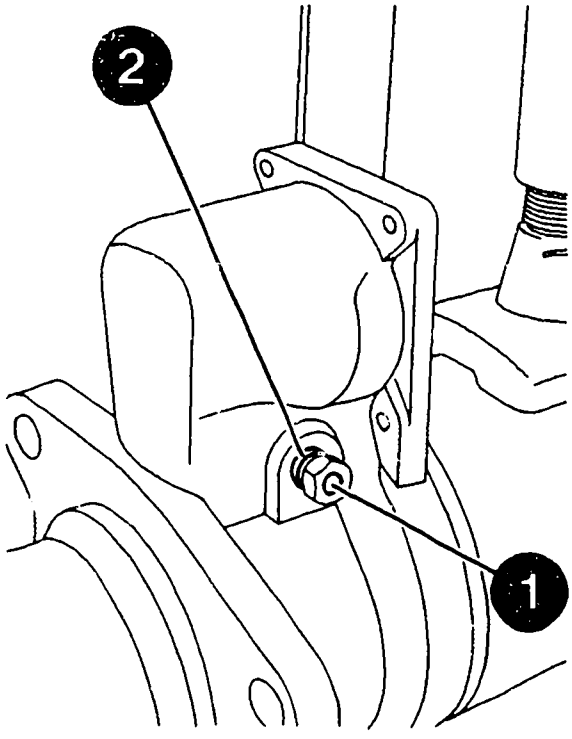
Screw out bearing pin (1) of engaging lever in drive-end bearing.

Note:
Use a new washer (2) on assembly.

Torx T40 bit socket: comm. avail.

Continue: II06/1 Fig.: II05/2

KMS00170



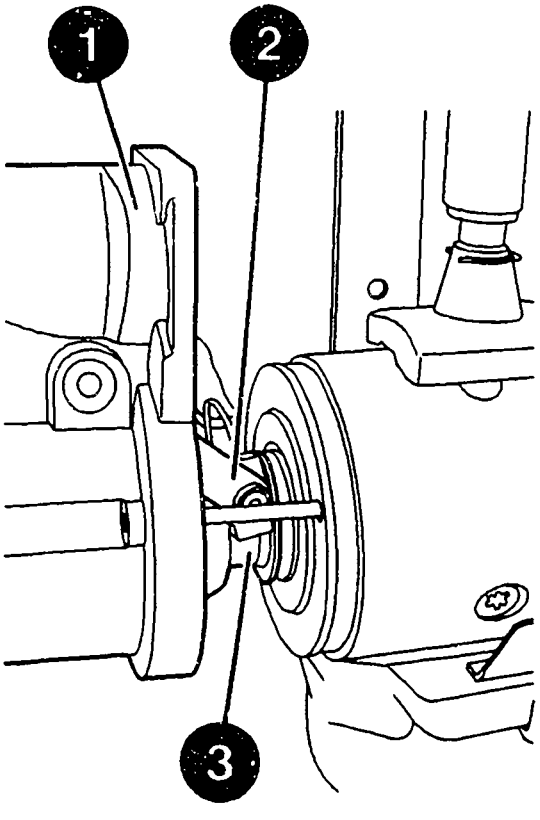
STARTING MOTOR DISASSEMBLY

Disassembling drive-end bearing

Remove drive-end bearing (1) with stay bolt from stator frame. In doing so, disengage engaging lever (2) from driver at overrunning-clutch drive (3).
ATTENTION: Make sure stay bolt does not damage excitation winding.

Continue: I23/1 Fig.: II06/2

KMS00217



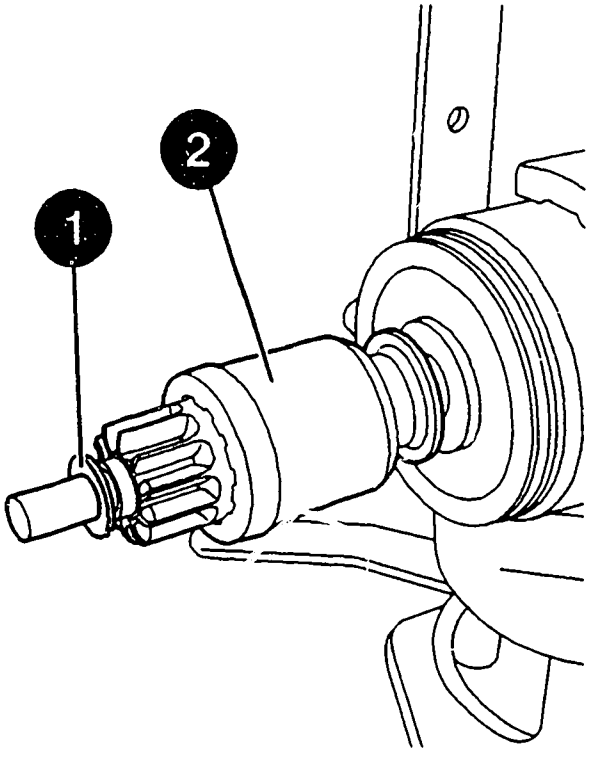
STARTING MOTOR DISASSEMBLY

Disassembling drive

Remove stop disk (1) and pinion with overrunning-clutch drive (2) from armature shaft.

Continue: I23/1 Fig.: II07/2

KMS00218



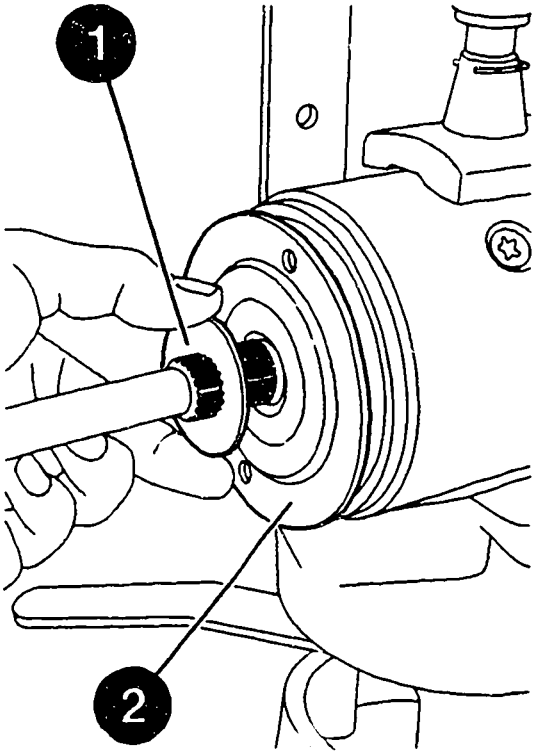
STARTING MOTOR DISASSEMBLY

Disassembling intermediate bearing

Remove brake disk (1) and intermediate bearing (2) from armature shaft.

Continue: I23/1 Fig.: II08/2

KMS00219



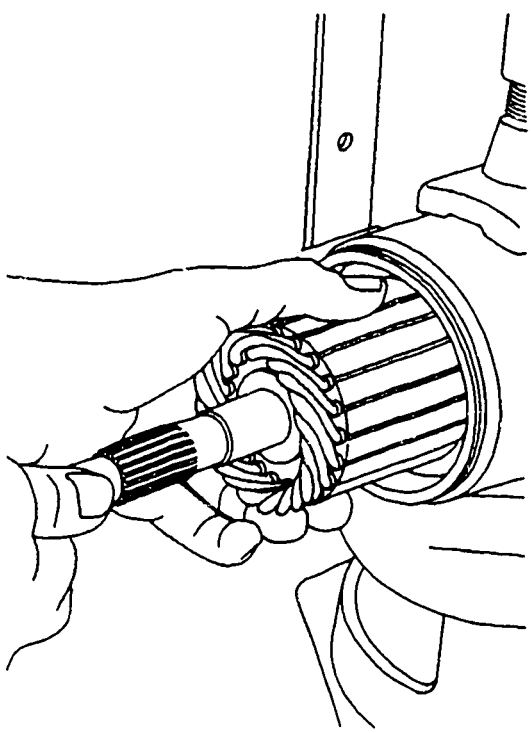
STARTING MOTOR DISASSEMBLY

Disassembling armature

Pull armature on drive end out of stator frame.
ATTENTION: Take care not to damage excitation winding.

Continue: I23/1 Fig.: II09/2

KMS00174



COMPONENT CLEANING

Component cleaning:
Armature, excitation winding, solenoid switch and overrunning-clutch drive are only to be cleaned using compressed air (max. 4 bar) and a clean cloth. Liquid cleaning agents are never to be employed.

Other parts such as intermediate and drive-end bearing can be washed out in commercially available cleaning agent which is not readily flammable. Take care not to inhale vapours.

Continue: II10/2

COMPONENT CLEANING

Danger of fire: Take care to avoid naked flames and sparking.

ATTENTION:
Make sure parts which have been cleaned are thoroughly dried, as gases subsequently forming in the sealed starting motor can lead to an explosion.

Continue: II11/1

COMPONENT CLEANING

Always heed the following safety regulations:

* German Order governing the use of flammable liquids (VbF).
* Accident prevention regulations for electrical systems and equipment.
* Safety regulations for the handling of chlorinated hydrocarbons:
  - For companies: ZH 1/222
  - For employees: ZH 1/129

  issued by the German industrial liability insurance associations (central association for accident prevention and industrial medicine), Langwartweg 103, 53129 Bonn.

Continue: II11/2

COMPONENT CLEANING

Outside Germany, pay attention to appropriate local regulations.

Skin protection:
To avoid skin irritation when handling oil and grease, apply hand cream before starting work and wash cream off when finished with soap and water.

Continue: I01/1

TESTING, REPAIR TABLE

Continue: II12/2

TESTING, REPAIR TABLE

Continue: I01/1

Checking pinion

Check pinion for scoring and chipping.
If necessary replace pinion complete with overrunning-clutch drive.
If end face of pinion is worn, engaging lever also has to be replaced in addition to overrunning-clutch drive.

Continue: II12/1

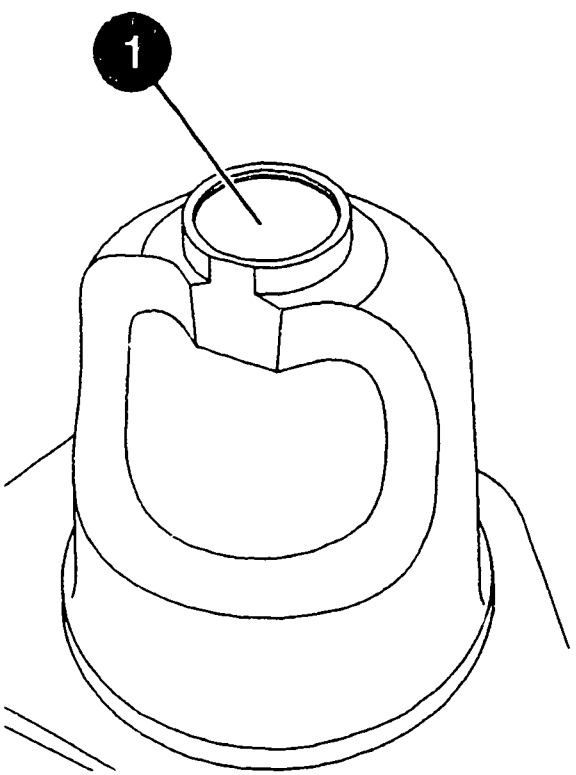
Checking drive-end bearing

Needle bushing of drive-end bearing is always to be replaced.
Removal: Disassemble stay bolt.
Use suitable mandrel to press plug (1) out of drive-end bearing from inside.

Stay bolt insertion and removal tool:	comm. avail.
Mandrel press:	comm. avail.

Continue: II15/1 Fig.: II14/2

KMS00220



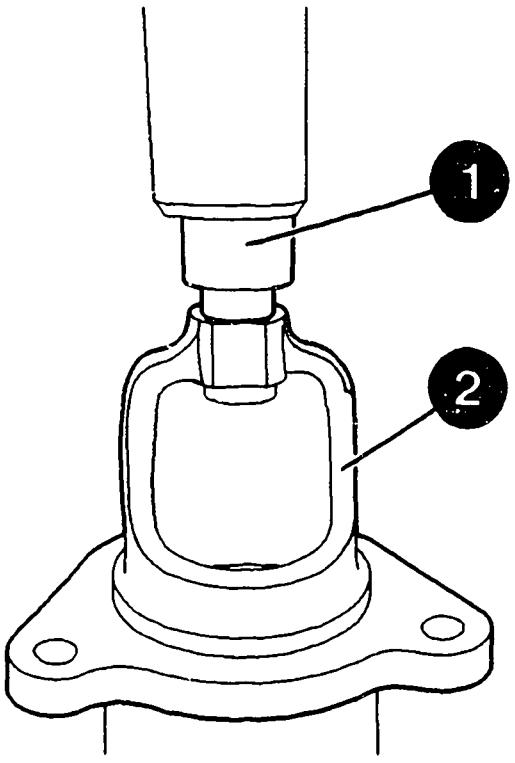
Checking drive-end bearing

Removal: Use pressing-out mandrel (1) to press needle bushing out of drive-end bearing (2).

Mandrel press:	comm. avail.
Pressing-out mandrel for needle bushing in drive-end bearing:	to be improvised

Continue: II16/1 Fig.: II15/2

KMS00175



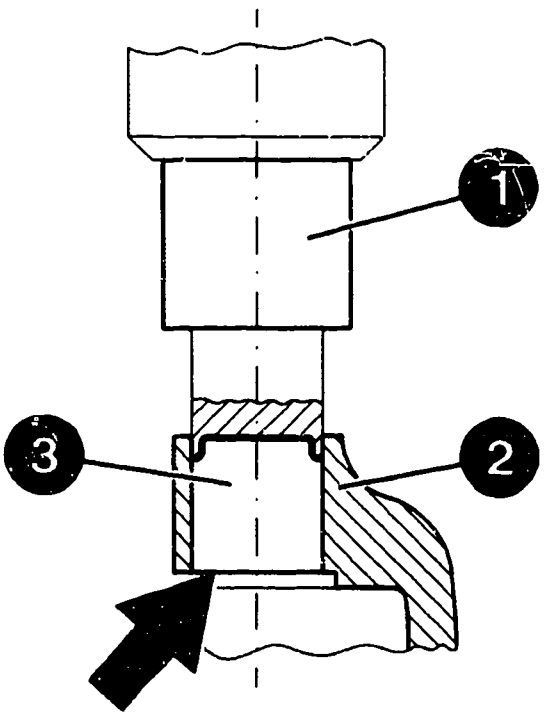
Checking drive-end bearing

Installation: Grease new needle bushing before pressing it in and then press from outside with pressing-in mandrel (1) into drive-end bearing (2) such that needle bushing (3) is flush on inside (arrow) with drive-end bearing.

Mandrel press:	comm. avail.
Pressing-in mandrel:	to be improvised
Grease VS 10832 Ft:	5 932 240 000

Continue: II12/1 Fig.: II16/2

KMS00391



COMPONENT TESTING AND REPAIR

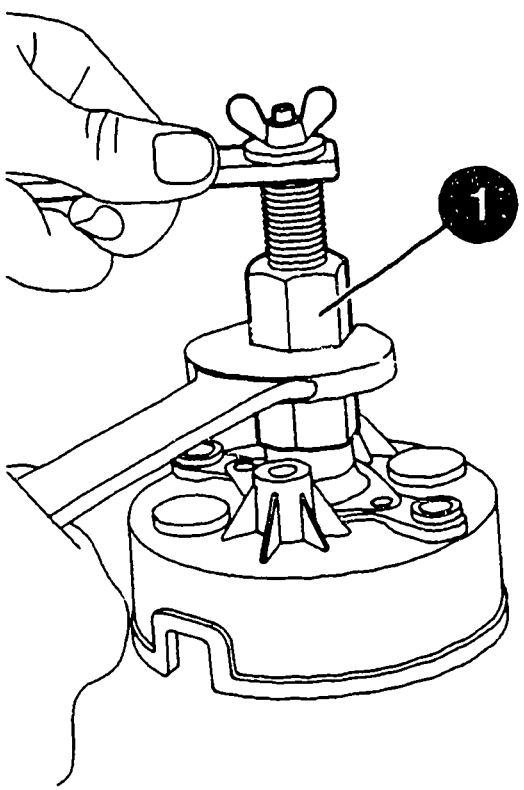
Testing commutator end shield

Check bushing for damage and running marks.
Replace if applicable.
Removing: Use puller (1) and spring collet to pull bushing out of commutator end shield.

Puller:	0 986 617 243
Spring collet diameter 14.3 mm:	0 986 617 251

Continue: II18/1 Fig.: II17/2

KMS00222



COMPONENT TESTING AND REPAIR

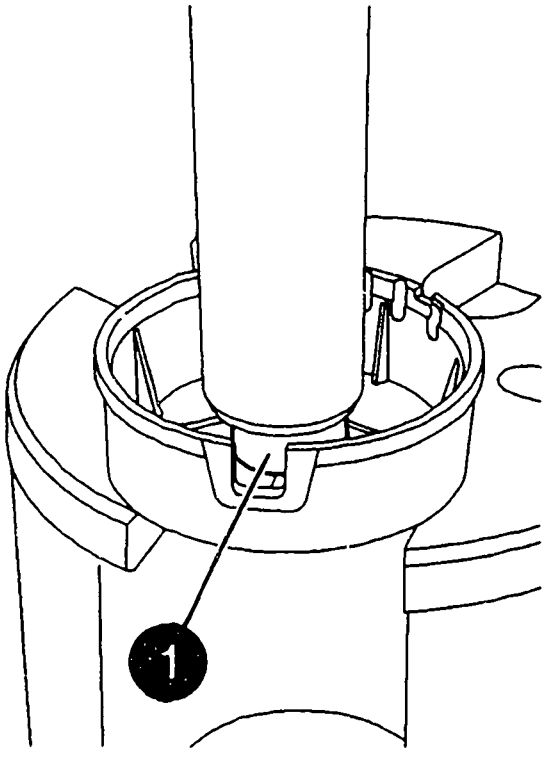
Testing commutator end shield

Installing: Use fitting mandrel (1) to press new bushing into commutator end shield from inside.
ATTENTION: Soak new bushing beforehand in oil for 1 hour.

Mandrel press:	comm. avail.
Fitting mandrel for bushing diameter 14.3 mm in commutator end shield:	Own make
Ö1VS13834-Ö1:	5 962 260 000

Continue: II12/1 Fig.: II18/2

KMS00223



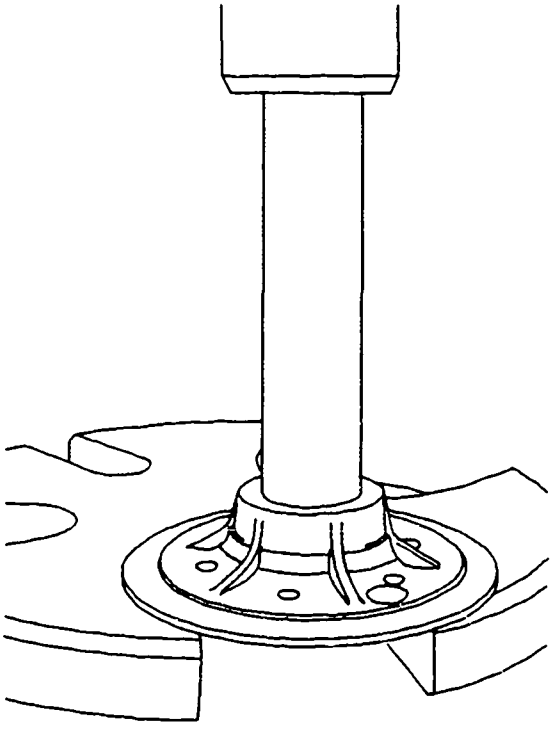
Checking intermediate bearing

Needle bushing of intermediate bearing is always to be replaced.
Removal: Press needle bushing out of intermediate bearing.

Mandrel press:	comm. avail.
Pressing-out mandrel for needle bushing in intermediate bearing:	0 986 617 129

Continue: II20/1 Fig.: II19/2

KMS00179



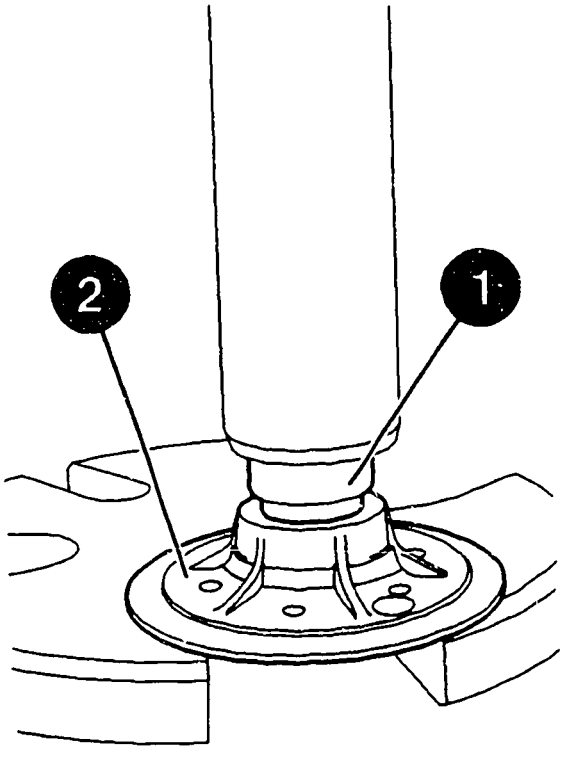
Checking intermediate bearing

Installing needle bushing:
Grease new needle bushing before pressing it in. Attach needle bushing to pressing-in mandrel (1) and press into intermediate bearing (2) as far as mandrel stop.

Mandrel press:	comm. avail.
Pressing-in mandrel for needle bushing in intermediate bearing:	to be improvised
Grease VS 10832 Ft:	5 932 240 000

Continue: II12/1 Fig.: II20/2

KMS00180

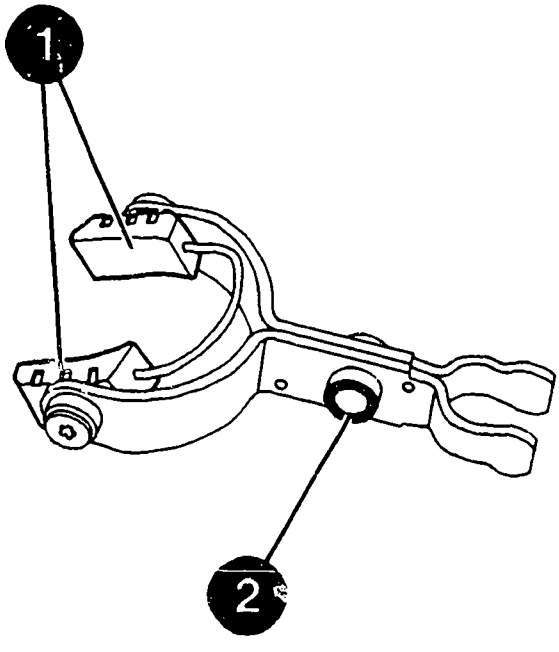


Checking engaging lever

If sliders (1) or bushing (2) of engaging lever are/is worn, engaging lever must be replaced.

Continue: II12/1 Fig.: II21/2

KMS00182



Checking drive

Check brake disk for damage and replace if necessary.

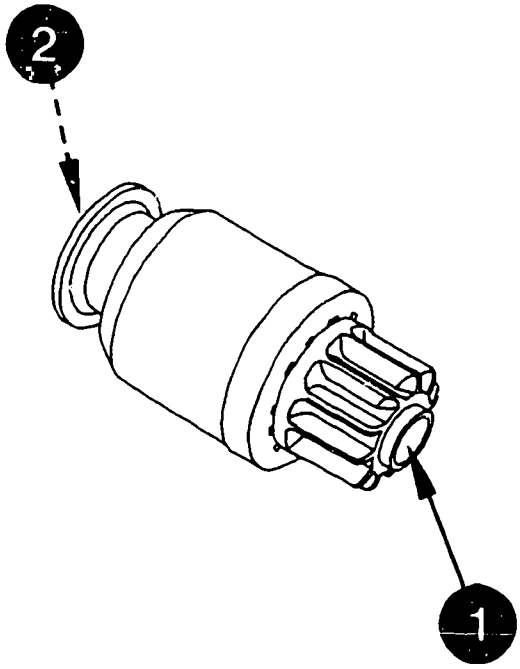
Continue: II23/1

Checking drive

In the event of scoring and damage to the mount (1) or spline-shaft profile (2), the entire overrunning-clutch drive must be replaced.

Continue: II24/1 Fig.: II23/2

KMS00184

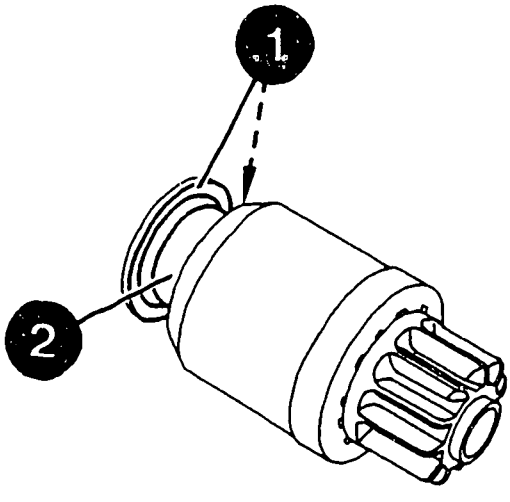


Checking drive

Check driver of engaging lever.
If edges (1) of driver (2) have been worn down by sliders of engaging lever, entire drive must be replaced.

Continue: II25/1 Fig.: II24/2

KMS00185



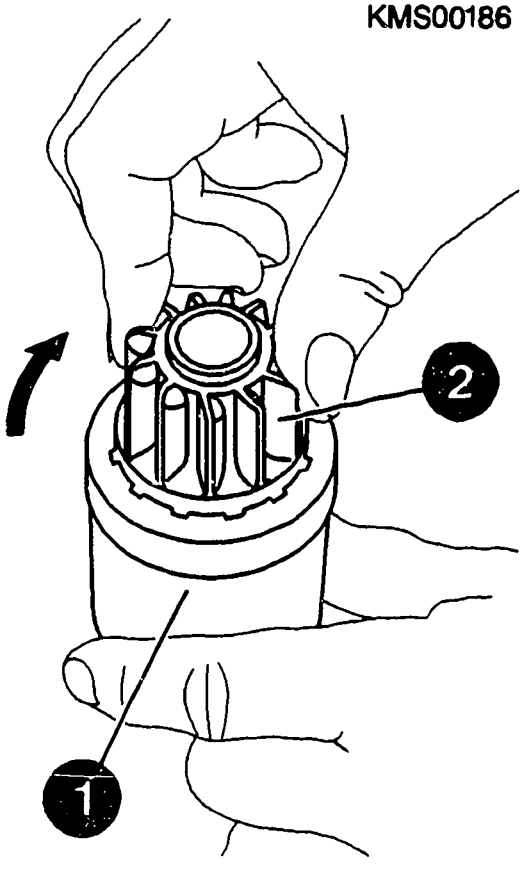
Checking drive

Check overrunning clutch.
Hold housing (1) of overrunning clutch and turn pinion (2) in direction of operation.
The clutch toothing must be heard to engage, thus indicating that the overrunning clutch is functioning properly.

Hold housing and turn pinion in opposite direction - friction locking must be found.

Continue: II26/1 Fig.: II25/2

KMS00186

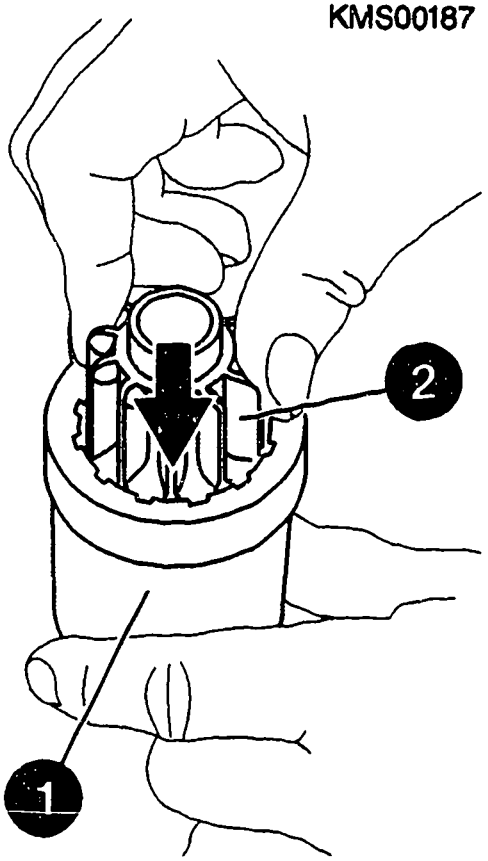


Checking drive

Check meshing spring.
Hold housing (1) of overrunning clutch and press pinion (2) into housing as far as it will go.
Pinion displacement: 10...11,4 mm
On release, pinion must return to its initial position.

Continue: II12/1 Fig.: II26/2

KMS00187



Checking carbon brushes

The carbon brushes and helical compression springs are always to be replaced.
Only use replacement parts given in the relevant list for the starting motor type.

Carbon brush as-new size:	15,5 mm
Carbon brush minimum size:	7,5 mm

Continue: II28/1

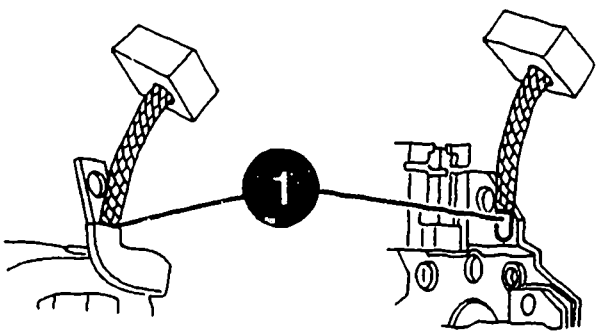
COMPONENT TESTING AND REPAIR

Testing carbon brushes

Removing: Pinch off standard wires of carbon brushes at soldered joint (1) at excitation winding/brush holder.

Continue: III01/1 Fig.: II28/2

KMS00224



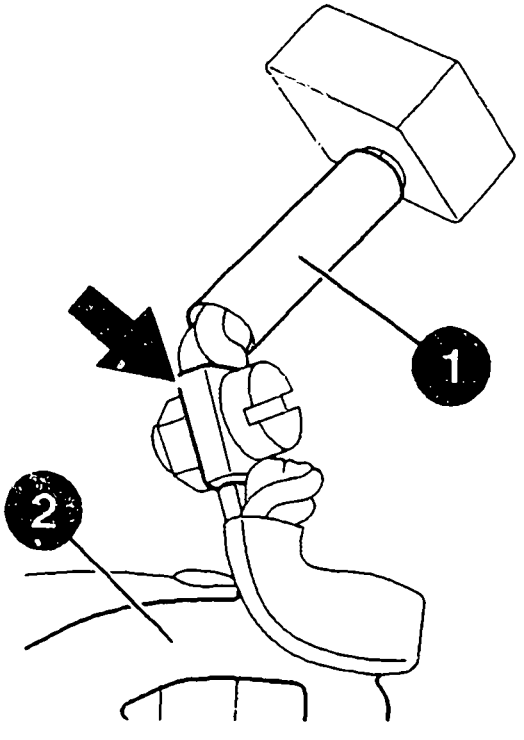
COMPONENT TESTING AND REPAIR

Testing carbon brushes

Installing positive carbon brushes: Screw (working inwards) replacement carbon brushes with red insulating sleeve (1) to excitation winding (2). Make sure terminals are properly positioned to ensure that they do not turn (see arrow).

Continue: III02/1 Fig.: III01/2

KMS00225

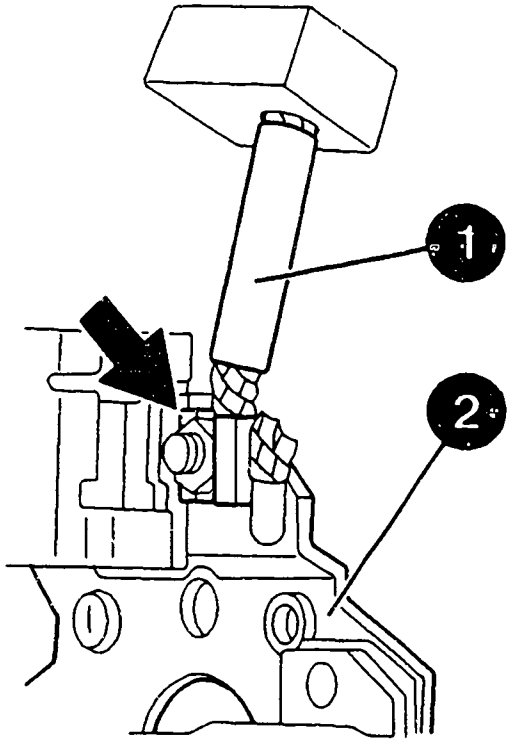


Checking carbon brushes

Installation of negative carbon brushes:
Screw replacement carbon brushes with blue insulating tube (1) to brush holder plate (2) starting from the outside and working inwards.
Pay attention to correct position of terminals so as to ensure locking (see arrow).
Watch out for ground terminal stud.

Continue: II12/1 Fig.: III02/2

KMS00226



Checking brush holder plate

Check brush holders (1), which are isolated from brush holder plate (2), for short to ground.

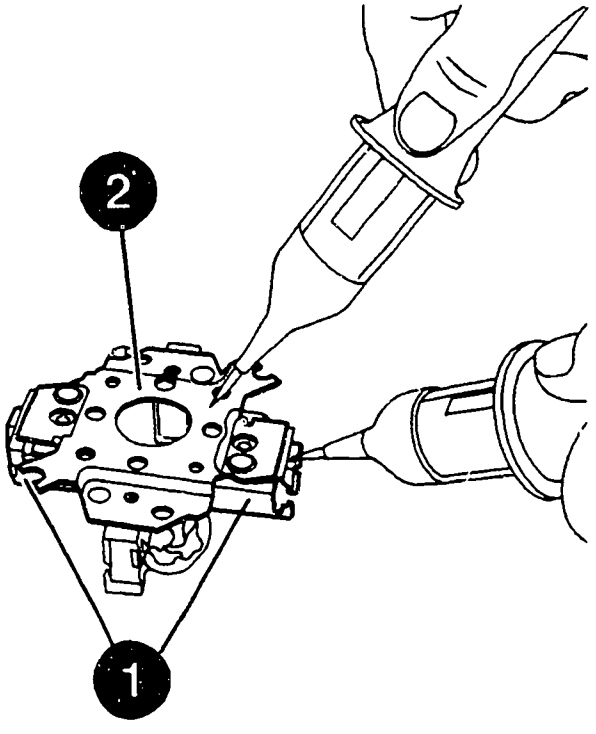
Interturn-short-circuit tester:	0 986 619 110
Test prods:	0 986 619 101

Test voltage when checking for short to ground:	80 V*

* = AC

Continue: II12/2 Fig.: III03/2

KMS00227

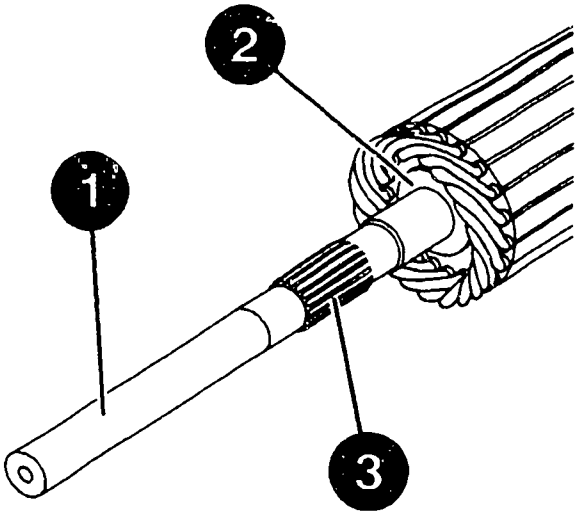


Checking armature

Examine bearing surface of overrunning-clutch drive (1) and intermediate bearing (2), as well as spline-shaft profile (3) for scoring and damage. Replace armature if necessary.

Continue: III05/1 Fig.: III04/2

KMS00189



COMPONENT TESTING AND REPAIR

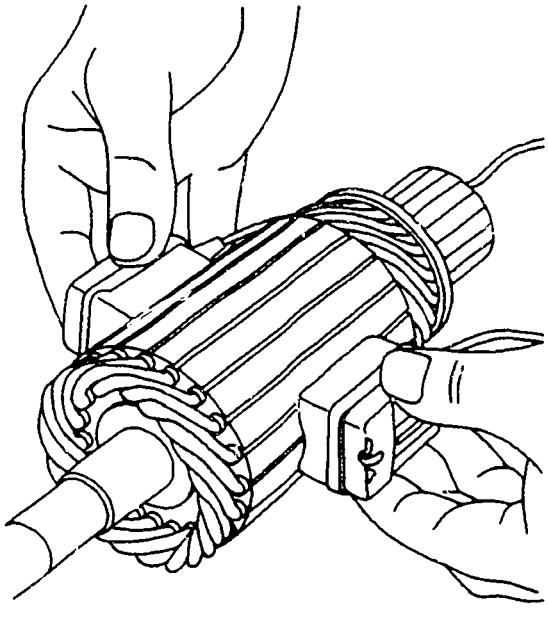
Testing armature

Check armature for interturn short circuit using tester and test probes.

Interturn short-circuit tester with test probes: 0 986 619 110

Continue: III06/1 Fig.: III05/2

KMS00228



Checking armature

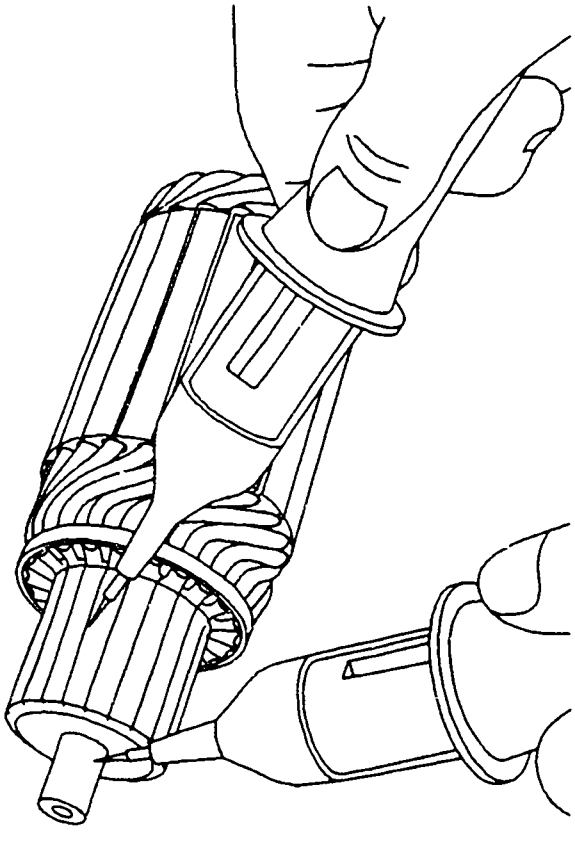
Use tester and test prods to check armature for short to ground and continuity (black laminations are an indication of open circuit)

Interturn-short-circuit tester:	0 986 619 110	
Test prods:	0 986 619 101	
Test voltage when checking for short to ground:	80	V*
Continuity test voltage: :	40	V*

* = AC

Continue: II12/2 Fig.: III06/2

KMS00229



Checking commutator

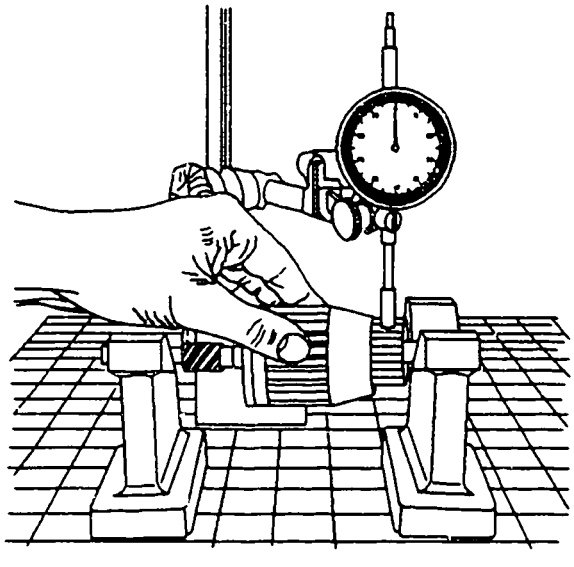
Check commutator for concentricity. Commutator must be turned down if eccentricity is outside stated range.

Magnetic measurement stand:	4 851 601 124
Dial gauge:	1 687 233 011

Eccentricity
- Commutator: < 0,03 mm
- Laminated core: < 0,08 mm

Continue: III08/1 Fig.: III07/2

KMS00192



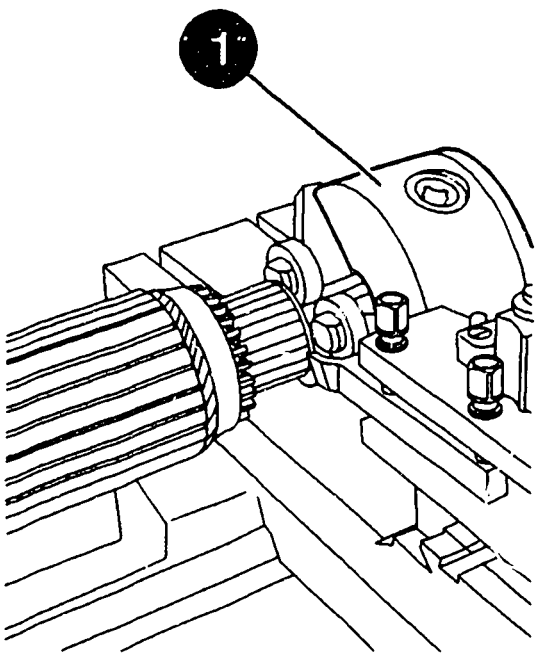
Checking commutator

For turning down, armature must be mounted in three-jaw chuck and tailstock chuck (1). The maximum machining thickness is 0.03 mm.
Pay attention to minimum diameter.

Tailstock chuck with Morse taper 2:	0 986 619 156
Minimum diameter:	42,5 mm

Continue: III09/1 Fig.: III08/2

KMS00193



Checking commutator

After turning down, the commutator segment insulation must be sawn out to a depth of 0.8 mm using a suitable tool.

Continue: III09/2

COMPONENT TESTING AND REPAIR

Checking commutator

After sawing out, turn dowm commutator again and check for interturn short circuit and short to ground. Pay attention to diameter.

Interturn-short-circuit tester:	0 986 619 110
Minimum diameter:	42,5 mm
Test voltage when checking for short to ground:	80 V*

* = AC

Continue: II12/2

Checking excitation winding

Use tester and test prods to check winding for short to ground.

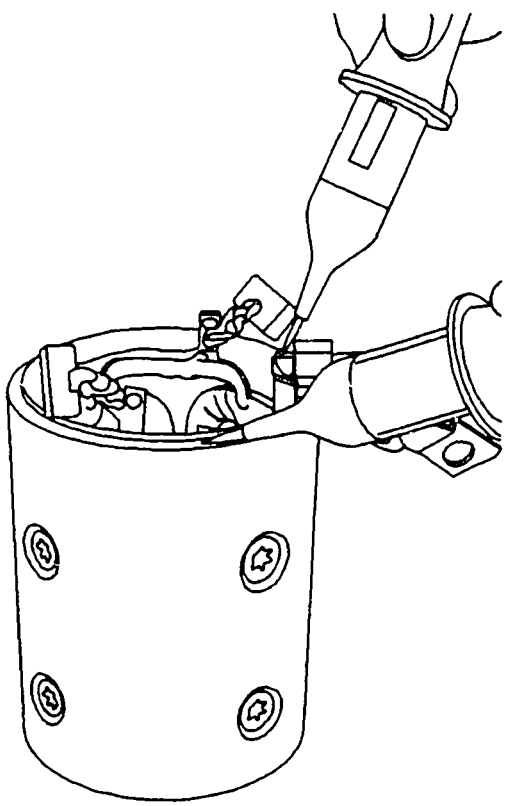
Interturn-short-circuit tester:	0 986 619 110
Test prods:	0 986 619 101

Test voltage when checking for short to ground:	80 V*

* = AC

Continue: III11/1 Fig.: III10/2

KMS00230



COMPONENT TESTING AND REPAIR

Testing excitation winding

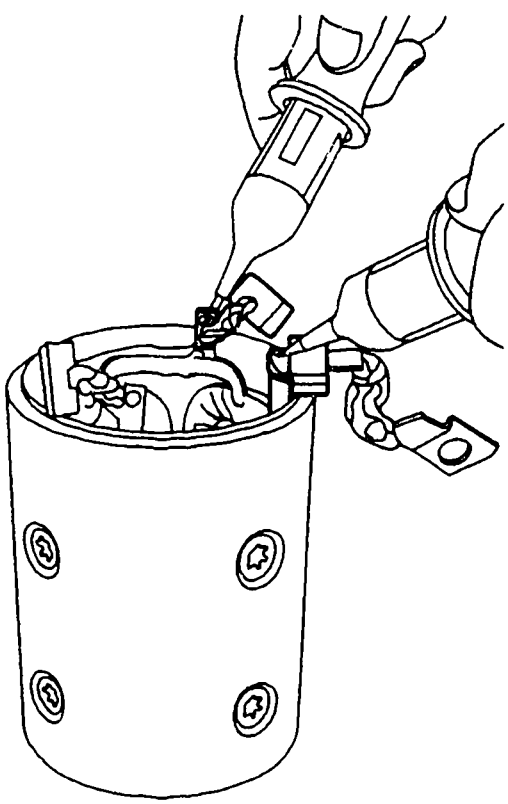
Use tester and test prods to check winding for continuity.

Interturn short-circuit tester:	0 986 619 110
Test prods:	0 986 619 101

Continuity test voltage: 40 V*
* = AC voltage

Continue: III12/1 Fig.: III11/2

KMS00231



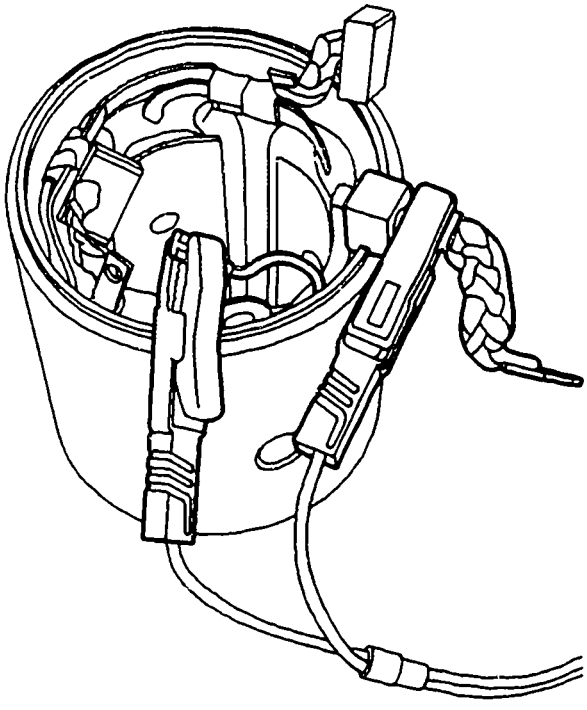
Checking excitation winding

Use tester to check resistance of shunt field.

Alternator tester:	0 684 201 200
Resistance of shunt field:	1,08...1,18 Ohm

Continue: II12/2 Fig.: III12/2

KMS00241



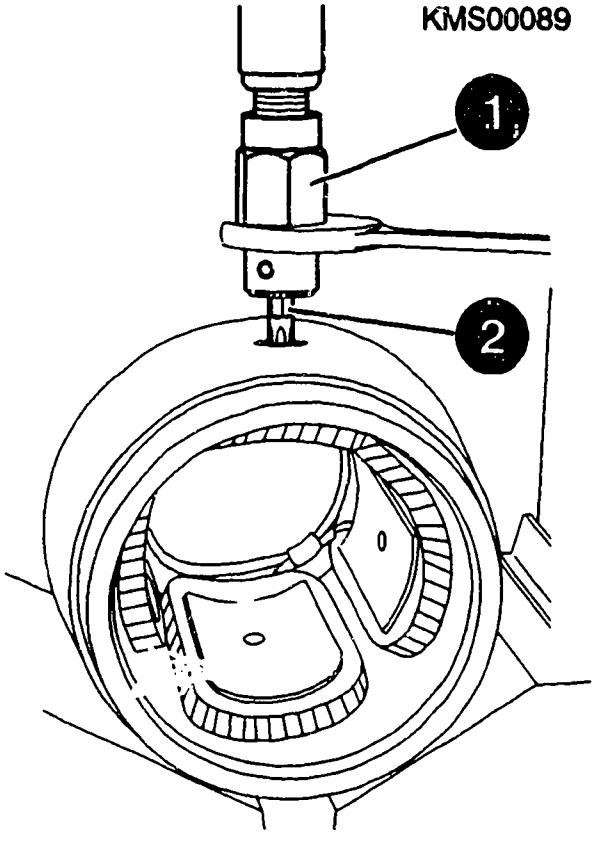
COMPONENT TESTING AND REPAIR

Replacing excitation winding

Replace damaged, defective, scorched or unsoldered windings.
Removing: Insert stator frame in clamping support, mark position of pole shoes.
Unfasten pole-shoe bolts with pole-shoe screwdriver (1) and Torx bit (2); remove pole shoes and winding in direction of drive-end bearing.

Clamping support:	0 986 619 362
Pole-shoe screwdriver:	0 986 619 393
Torx T50 bit with 5/16" hexagon:	comm. avail.

Continue: III14/1 Fig.: III13/2

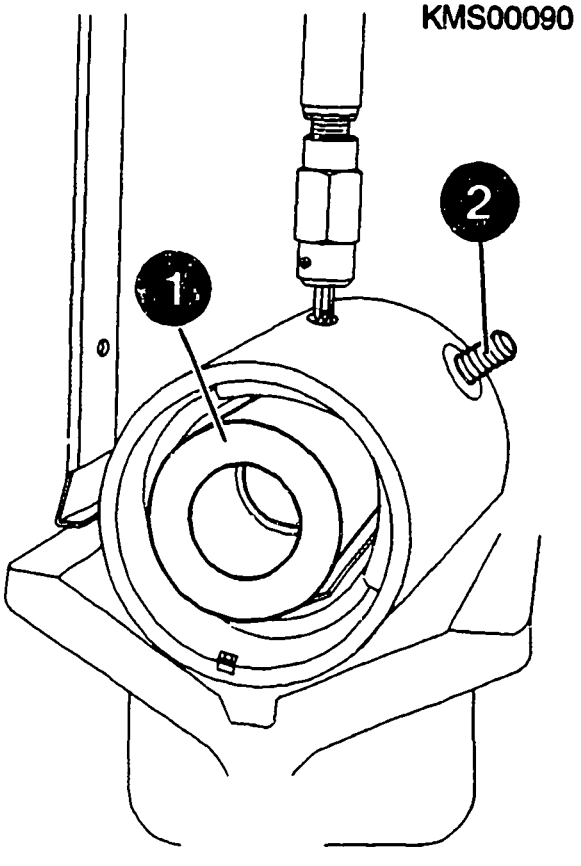


Replacing excitation winding

Installing: Heat excitation winding before fitting, insert with pole shoes from drive end in stator frame and slightly tighten pole-shoe bolts. Pay attention to markings.
Press in fitting mandrel (1).

Mandrel press:	comm. avail.
Fitting mandrel diameter:	75,80...75,85 mm (own make)

Continue: III15/1 Fig.: III14/2



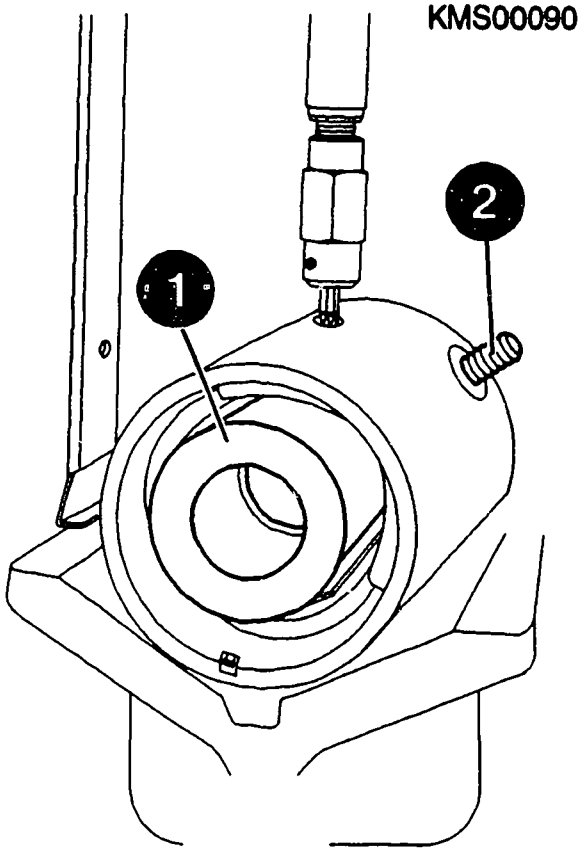
COMPONENT TESTING AND REPAIR

Replacing excitation winding

Tighten pole-shoe bolts and press out fitting mandrel (1).

Mandrel press:	comm. avail.
Pole-shoe screwdriver:	0 986 619 393
Torx T50 bit with 5/16" hexagon:	comm. avail.
Torque wrench:	comm. avail.
Tightening torque of pole-shoe bolts:	40...53 Nm

Continue: II12/2 Fig.: III15/2

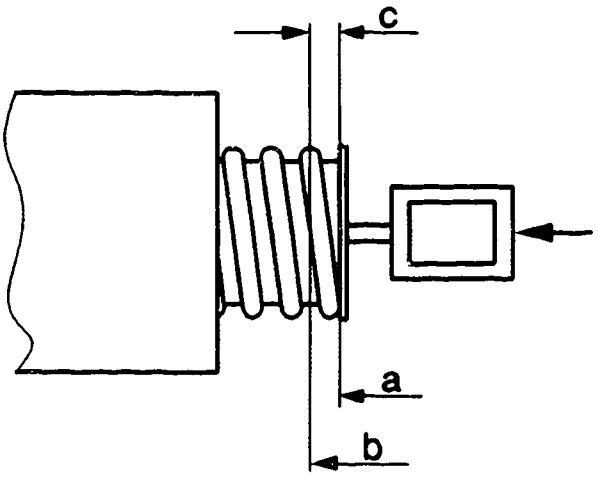


Testing solenoid switch

Examine solenoid switch for damage.
Check burn-off reserve.
Press in armature by hand until current bridge is resting (a) on terminal stud. On pressing in the armature further as far as stop (b) a noticeable increase in force is apparent. The difference between positions (a) and (b) is the burn-off reserve (c). If there is no further burn-off reserve, the solenoid switch must be replaced.

Continue: III17/1 Fig.: III16/2

KMS00238



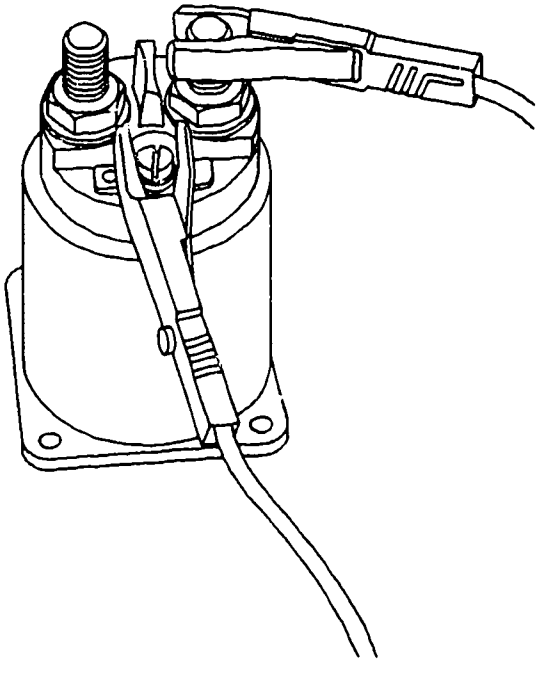
Checking solenoid switch

Use tester to check resistance of pull-in winding (term. 50/term. 30-f).

Alternator tester:	0 684 201 200
Resistance:	0,524...0,552 Ohm

Continue: III18/1 Fig.: III17/2

KMS00239



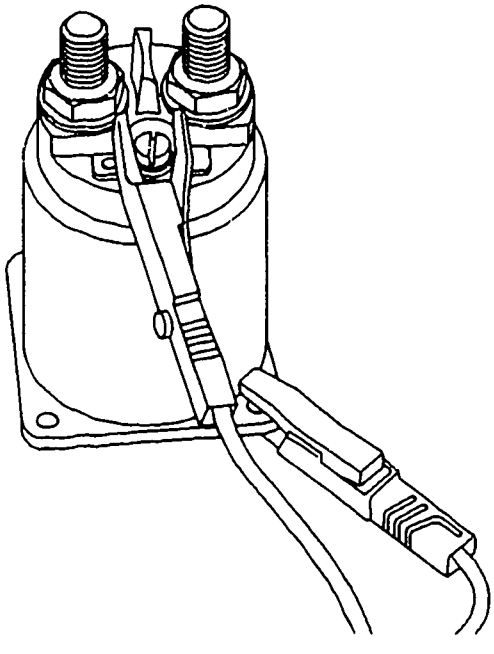
Checking solenoid switch

Use tester to check resistance of holding winding (term. 50/ground).

Alternator tester:	0 684 201 200
Resistance:	1,6...1,7 Ohm

Continue: III19/1 Fig.: III18/2

KMS00240



COMPONENT TESTING AND REPAIR

Testing solenoid switch

Neither the tests described, nor proper functioning of the solenoid switch when testing the function of the starting motor following repairs can provide reliable information on long-term trouble-free operation of the solenoid switch.
It is therefore advisable to renew the solenoid switch when the starting motor is repaired.

Continue: II12/2

STARTING MOTOR ASSEMBLY TABLE

Continue: I01/1

Assembling intermediate bearing

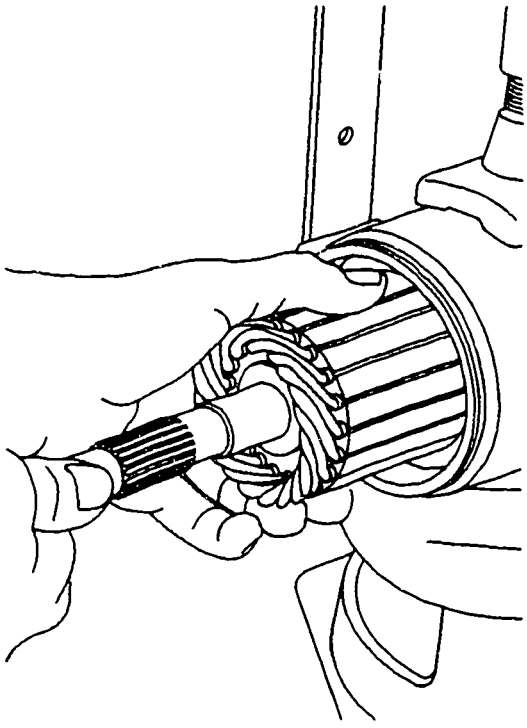
Lubricate as per lubrication schedule before and during assembly.

Clamp stator frame in clamping support. Insert armature into stator frame from drive end.
ATTENTION: Take care not to damage excitation winding.

Clamping support: 0 986 619 362

Continue: III22/1 Fig.: III21/2

KMS00174



STARTING MOTOR ASSEMBLY

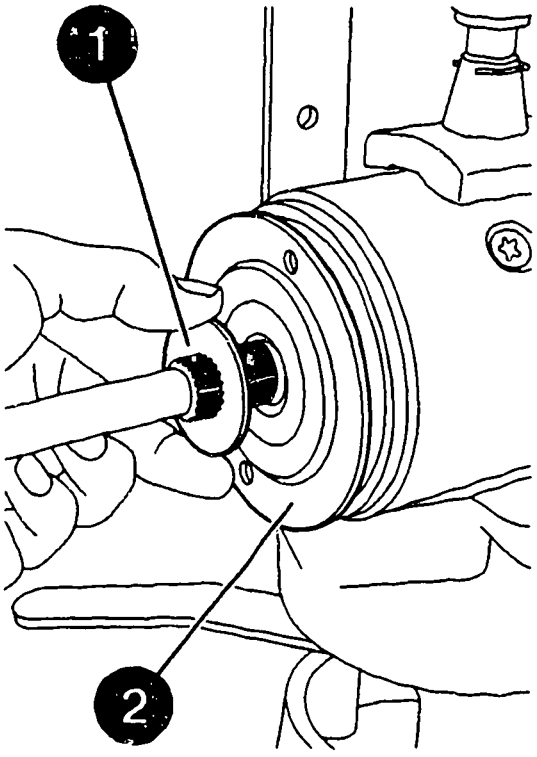
Assembling intermediate bearing

Slip intermediate bearing (2) with collar facing armature winding and brake disk (1) onto armature shaft.

Clamping support: 0 986 619 362

Continue: III20/1 Fig.: III22/2

KMS00219



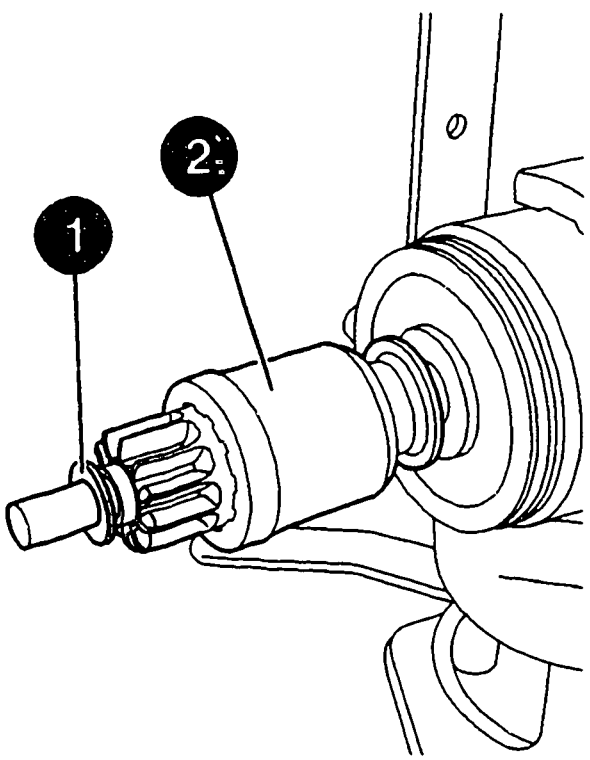
STARTING MOTOR ASSEMBLY

Assembling drive

Slip overrunning-clutch drive with pinion (2) and stop disk (1) onto armature shaft.
ATTENTION: Spline-shaft profile of drive must be dry and free from grease to stop armature shaft becoming pasty. Only grease spline-shaft profile of armature shaft.

Continue: III20/1 Fig.: III23/2

KMS00218



STARTING MOTOR ASSEMBLY

Assembling drive-end bearing

Install stay bolt in drive-end bearing.

Stay bolt insertion and removal tool:	comm. avail.
Tightening torque:	9,1...12,2 Nm

Continue: III25/1

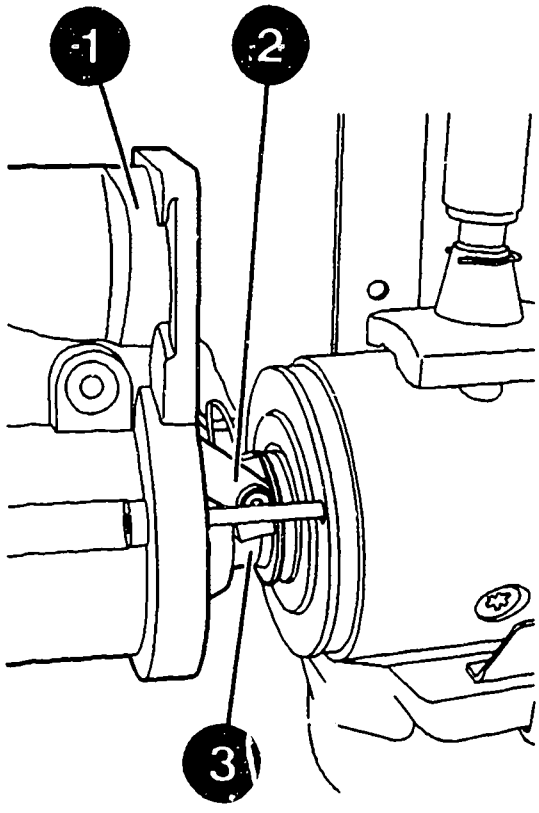
STARTING MOTOR ASSEMBLY

Assembling drive-end bearing

Slip on drive-end bearing (1) together with engaging lever (2) and insert into driver (3) at drive.
ATTENTION: Take care not to damage excitation winding.
Pay attention to marking of drive-end bearing. Ensure correct positioning of engaging lever in driver of over-running-clutch drive and of armature shaft in drive-end bearing.
DANGER OF INJURY
The drive-end bearing is not fixed in position at the stator frame.

Continue: III26/1 Fig.: III25/2

KMS00217



STARTING MOTOR ASSEMBLY

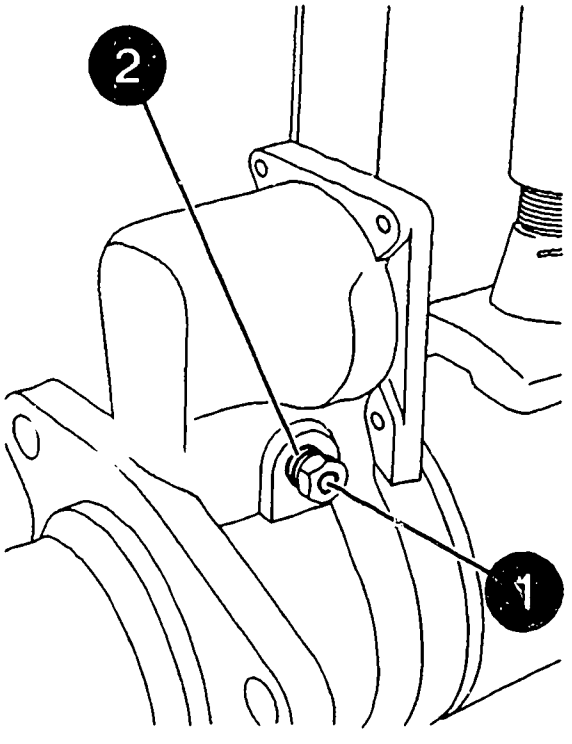
Assembling drive-end bearing

If applicable, renew bearing pin (1) of engaging lever, fit with new washer (2) and secure with Loctite. Make sure engaging lever moves easily on bearing pin.
Use torque wrench.

Torque wrench:	comm. avail.
Tightening torque (hexagon nut):	9...11 Nm
Loctite VS 14618 Kk:	5 965 930 512

Continue: III20/1 Fig.: III26/2

KMS00170



STARTING MOTOR ASSEMBLY

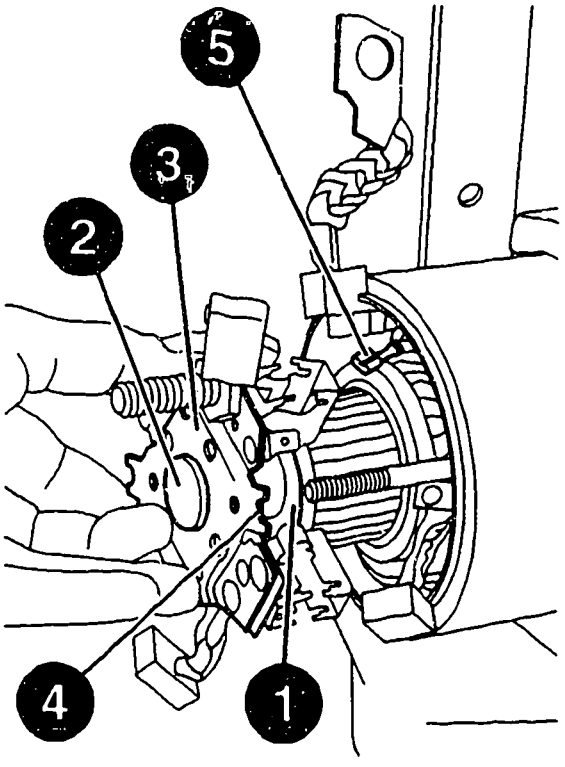
Assembling brush holder plate

Slip thrust washer (1) and locating sleeve (2) onto armature shaft.
Slip brush holder plate (3) over locating sleeve.
Pay attention to locking element (4).
Attach blade terminal of shunt winding (5).

Locating sleeve for brush holder plate: to be improvised

Continue: III20/1 Fig.: III27/2

KMS00233



STARTING MOTOR ASSEMBLY

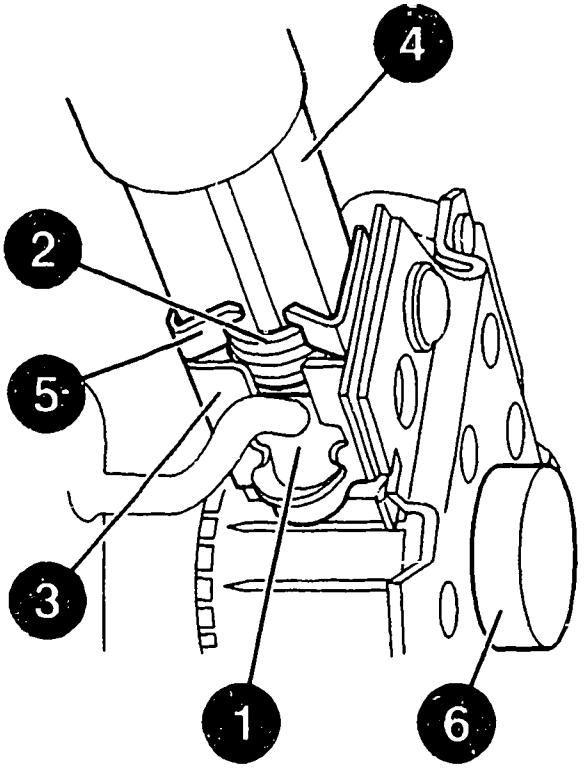
Assembling carbon brushes

Insert carbon brushes (1) and helical compression springs (2) in cartridge-type brush holder (3) and press down with assembly tool (4).

Carbon brush assembly tool: 0 986 617 117

Continue: IV01/1 Fig.: III28/2

KMS00234



STARTING-MOTOR ASSEMBLY

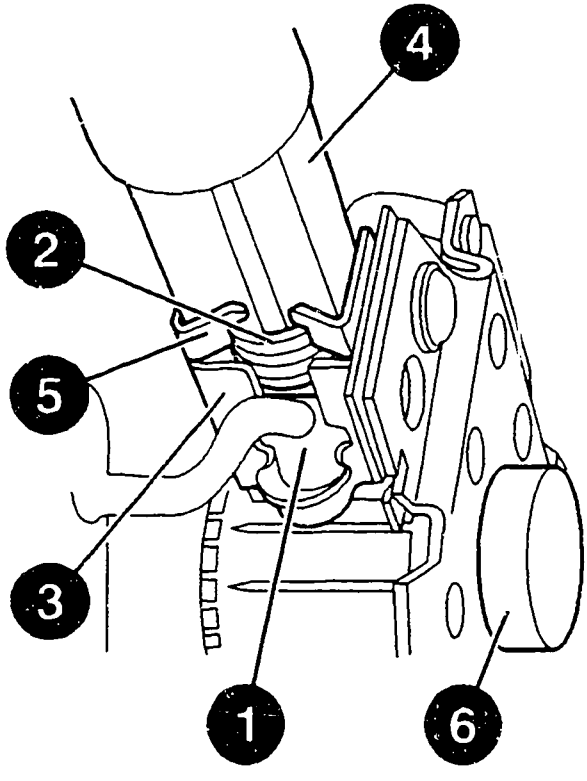
Carbon-brush assembly

Use flat-nosed pliers to bend round retaining lugs (5) in line with shape of assembly tool.
Removing centering sleeve (6).
Pay attention to freedom of movement of carbon brushes.
Press stranded wires of carbon brushes outwards to prevent contact with commutator.

Flat-nosed pliers: comm. avail.

Continue: III20/1 Fig.: IV01/2

KMS00234



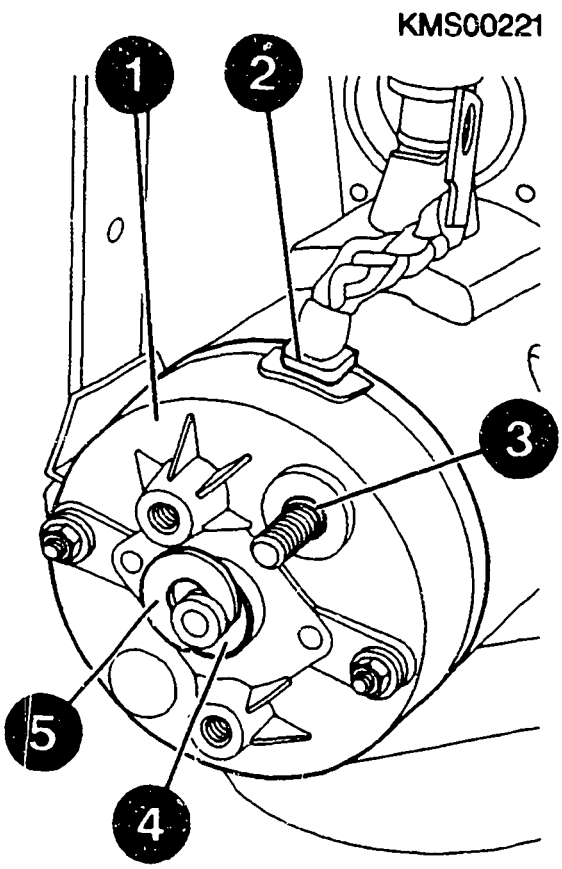
STARTING MOTOR ASSEMBLY

Assembling commutator end shield

Slip on commutator end shield (1). Pay attention to correct positioning of rubber grommet (2) at connection of excitation winding.
Slip insulating sleeve (3) onto ground terminal stud. Secure commutator end shield and ground terminal stud.

Torque wrench:	comm. avail.
Commutator end shield tightening torque:	9,1...12,2 Nm
Ground terminal stud:	12...15 Nm

Continue: IV03/1 Fig.: IV02/2

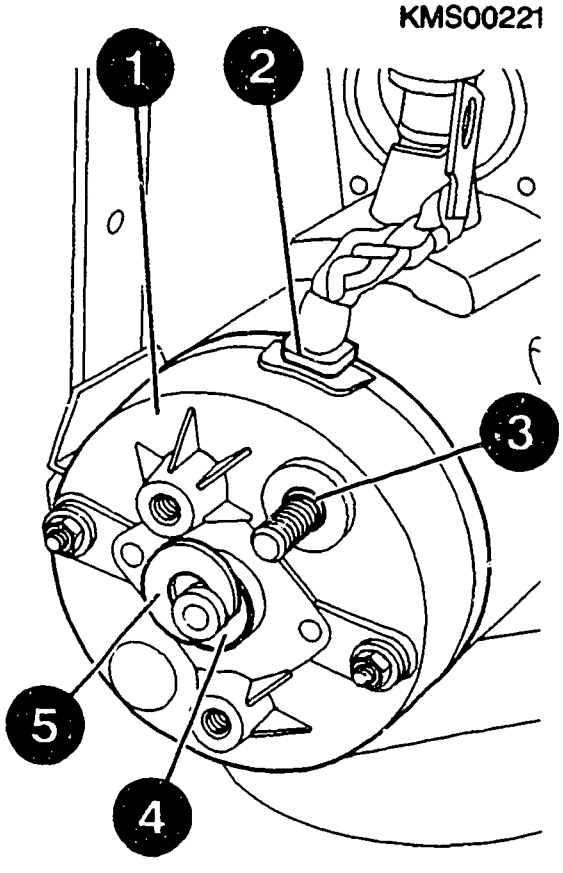


STARTING MOTOR ASSEMBLY

Assembling commutator end shield

Slip shim (4) onto armature shaft and insert positioning washer (5) in annular groove. Use is only to be made of a shim (> 0.5 mm).

Continue: III20/1 Fig.: IV03/2



STARTING-MOTOR ASSEMBLY

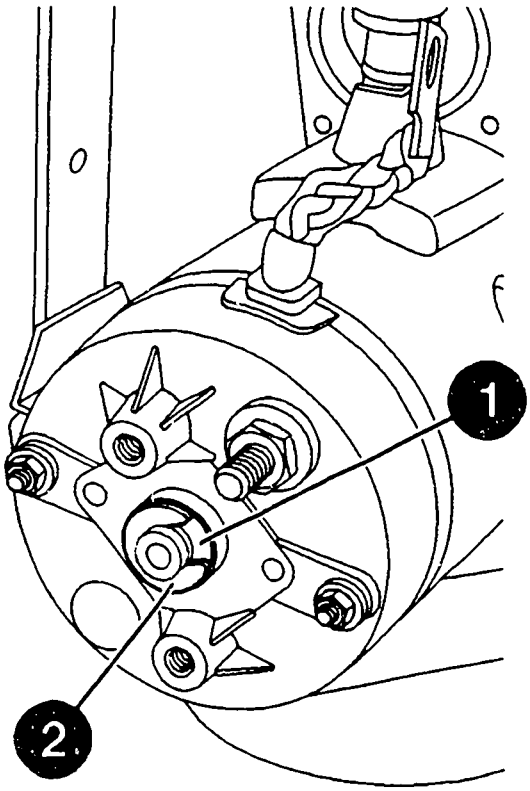
Checking and adjusting armature axial clearance

Use shim (1) to adjust armature axial clearance. Only use shim of appropriate thickness (> 0.5 mm). If several shims are needed, the thickest shim (> 0.5 mm) must be in contact with the locating washer (2).
Check freedom of movement of armature.

Armature axial play: 0,05...0,40 mm

Continue: III20/1 Fig.: IV04/2

KMS00235



STARTING-MOTOR ASSEMBLY

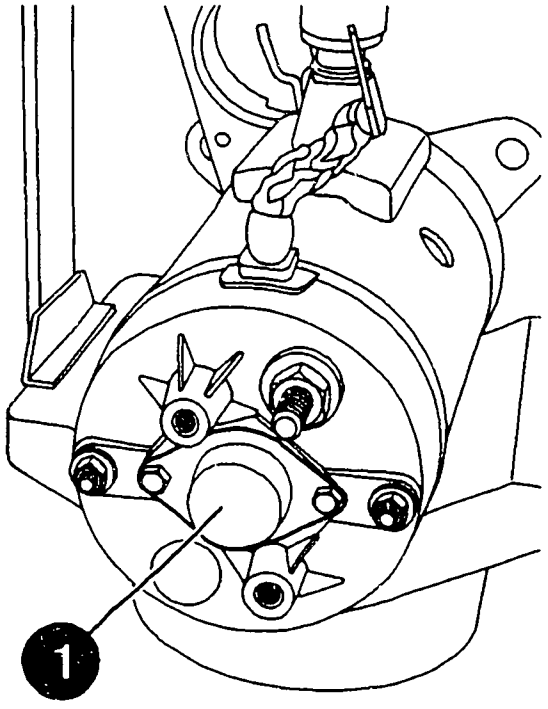
Bearing end plate assembly

Fill 1/3 of bearing end plate with grease.
Slip new seal over collar of commutator end shield and attach bearing end plate (1). Use torque wrench.

Torque wrench:	comm. avail.
Grease VS 10832 Ft:	5 932 240 000
Tightening torque:	4,5...6,0 Nm

Continue: III20/1 Fig.: IV05/2

KMS00236



STARTING MOTOR ASSEMBLY

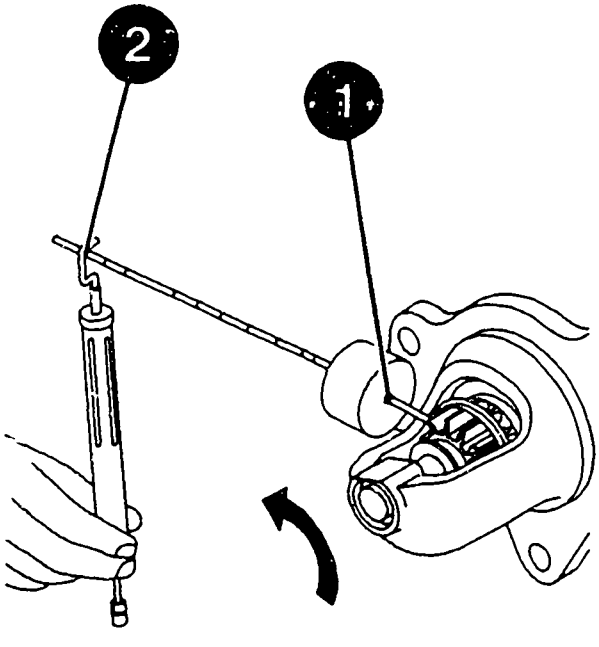
Checking armature braking torque

Suspend torque meter from pinion such that it is loaded in direction of operation (see arrow). Move torque meter to horizontal position.
Move weight to second mark 2.0 (1).
Suspend spring balance at last mark 8 (2).

Torque meter:	0 986 617 206
Spring balance:	0 986 619 181

Continue: IV07/1 Fig.: IV06/2

KMS00242



STARTING MOTOR ASSEMBLY

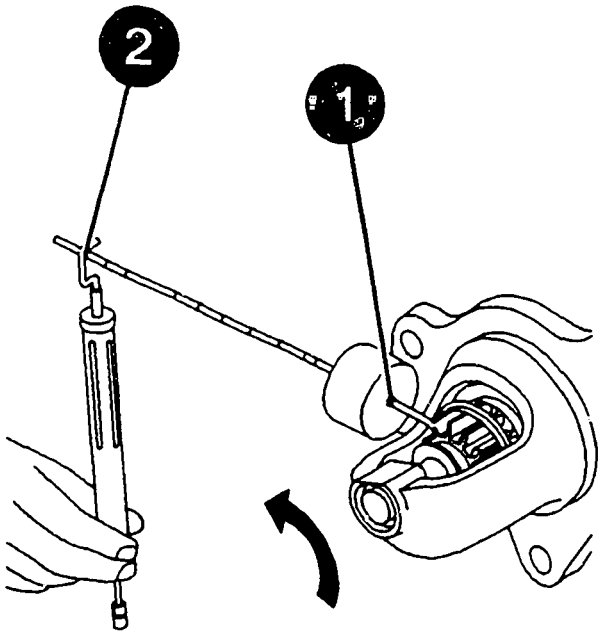
Checking armature braking torque

Pull on spring balance until pinion with armature starts to rotate.
Take spring-balance scale reading.
This must be between 0,21...0,35 kg, corresponding to a tensile force of 2,0...3,40 N.
The armature braking torque is then within the required range. If it is outside the stated range, check components and component assembly.

Armature braking torque: 0,8...1,2 Nm

Continue: III20/1 Fig.: IV07/2

KMS00242



STARTING MOTOR ASSEMBLY

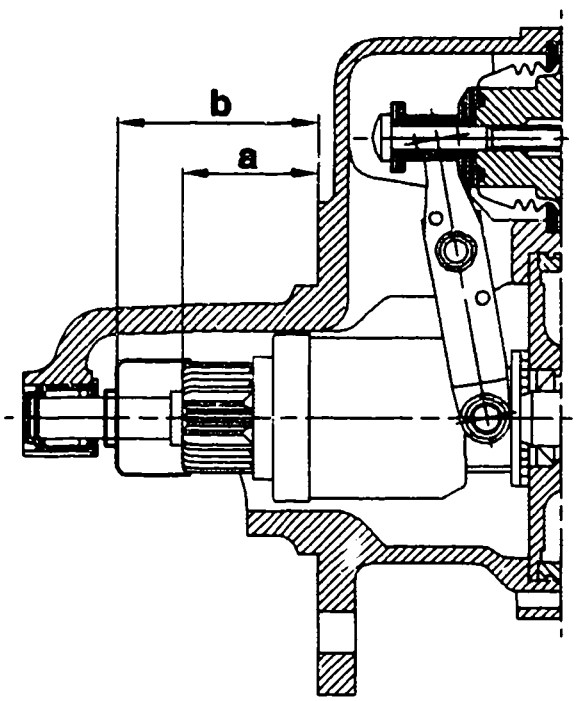
Checking pinion rest position

Dimension a for the pinion rest position and dimension b for the total pinion travel must be within the stated range.
If not, check components and component assembly.

Pinion rest position a:	47...49 mm
Total pinion travel b:	68,2...70,8 mm

Continue: III20/1 Fig.: IV08/2

KMS00206

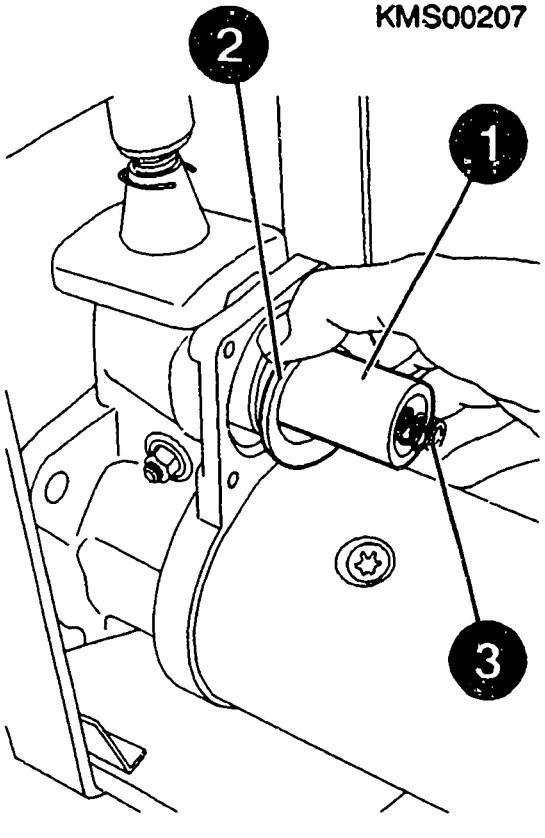


STARTING MOTOR ASSEMBLY

Assembling solenoid switch

Re-clamp starting motor.
Press pinion against stop disk, grasp switch armature (1) at bellows (2) and engage at engaging lever. Pay attention to return spring (3).

Continue: IV10/1 Fig.: IV09/2



STARTING MOTOR ASSEMBLY

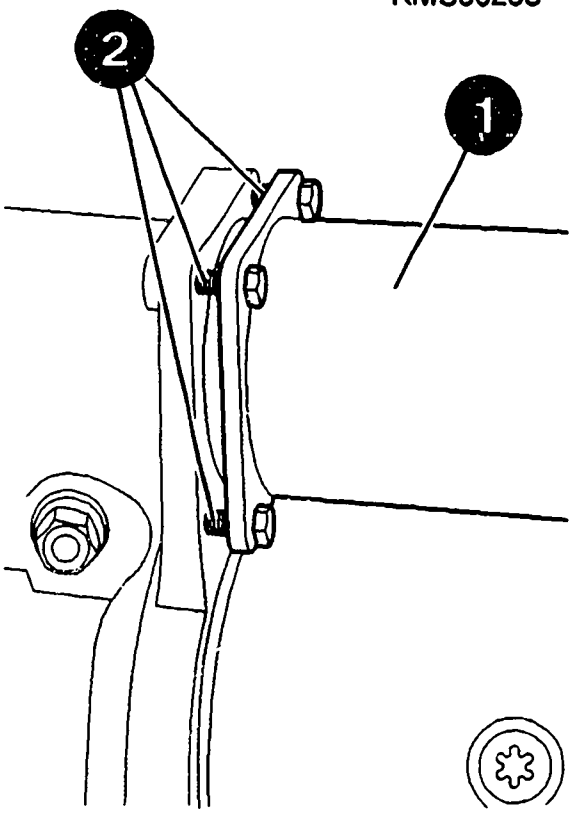
Assembling solenoid switch

Slip solenoid switch (1) onto switch armature and screw on at drive-end bearing. Secure bolts (2) with Loctite.
Use torque wrench.

Torque wrench:	comm. avail.
Loctite VS 14618 Kk:	5 965 930 512
Tightening torque:	6,7...8,4 Nm

Continue: IV11/1 Fig.: IV10/2

KMS00208



STARTING MOTOR ASSEMBLY

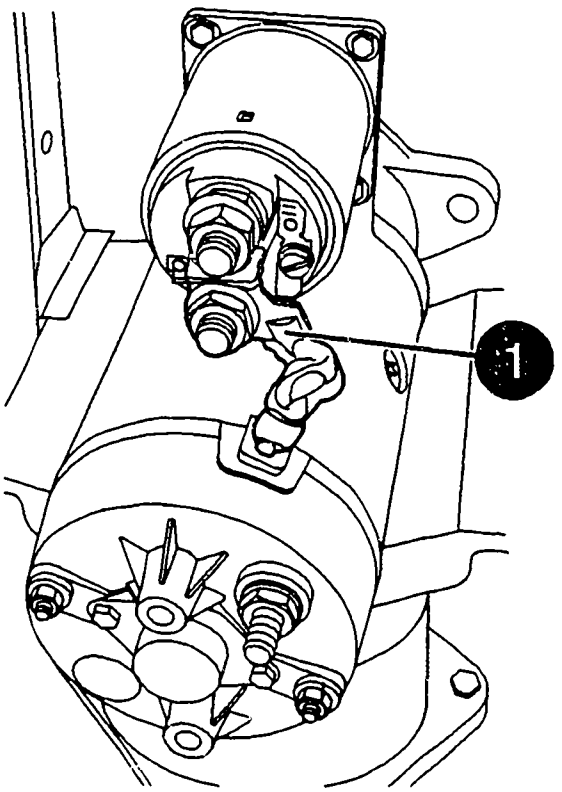
Assembling solenoid switch

Attach connection of excitation winding (1) to solenoid switch.

Tightening torque: 16...20 Nm

Continue: III20/1 Fig.: IV11/2

KMS00209



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Continue: IV12/2

EDITORIAL NOTE

Continue: I01/1